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New species of *Geissorhiza* (Iridaceae: Crocoideae) from the southern African winter rainfall zone, range extensions, taxonomic changes, and notes on pollen morphology and floral ecology

P. GOLDBLATT*, J.C. MANNING** and I. NÄNNI***

Keywords: Apoidea, compatibility, Empididae, floral biology, *Geissorhiza* Ker Gawl., nectar characteristics, Nemestrinidae, new keys, new species, pollen morphology, pollination, southern Africa, Tabanidae, taxonomy

ABSTRACT

Field work during the past 15 years has resulted in the discovery of 12 new species of the western southern African genus *Geissorhiza* Ker Gawl. and range extensions for several more. Following a survey of pollen morphology in the genus, we describe new pollen types in one section each of the two subgenera: five species of section *Ciliatae* Goldblatt and two of section *Weihea* Eckl. ex Baker have more complex apertures than the plesiomorphic single aperture with a 2-banded operculum found in other species. In addition, populations currently referred to the typical white (cream)-flowered *G. inflexa* (D.Delaroche) Goldblatt with larger, pink, red or purple flowers, have a third pollen type and are recognized as *G. erosa* (Salisb.) R.C.Foster. The new species are *G. altimontana* from the high Langeberg near Grootvadersbos; *G. helmei* from the Piketberg; *G. lapidosa* from the Du Toits Kloof Mtns; *G. monticola* from the Swartberg; *G. platystigma* from Darling, north of Cape Town; *G. sufflava* from the Piketberg; *G. tricolor* from Riversdale (all subgenus *Weihea* (Eckl. ex Baker) Goldblatt); and *G. cantharophila* from the Klein Roggeveld; *G. demissa* from the Kamiesberg, Gifberg and Cold Bokkeveld; *G. exilis* from the Waaihoek Mtns in the Worcester District; *G. reclinata* from the Swartberg; and *G. saxicola* from the northern Cedarberg–Pakhuis Mountain complex (all subgenus *Geissorhiza*). We also report range extensions and provide morphological notes for several species, including *G. monanthos* Eckl., new collections of which show that the inclusion of *G. lewisiae* R.C.Foster in that species was incorrect and we resurrect the species. The addition of 12 new species and recognition of *G. erosa* and *G. lewisiae* bring to 99 the number of species in the genus. New identification keys for *Geissorhiza* are provided that include all new species. We have also accumulated observations of floral ecology in the genus and integrate them with what is known about this aspect of the biology of *Geissorhiza*. Unusual strategies include deceptive pollination in *G. tulbaghensis* F.Bolus by tabanid flies and in two species, pollination using empid flies in combination with halictid bees.

INTRODUCTION

Geissorhiza Ker Gawl., now with 99 species, is a large genus of Iridaceae subfamily Crocoideae Burnett centred in the southern African winter rainfall zone (Goldblatt 1985; Goldblatt & Manning 2000a; Manning *et al.* 2002) and largely confined to the Cape floristic region (as defined by Goldblatt & Manning 2000a). Field work conducted in the decade since the publication of the last revision of the genus (Goldblatt 1985) resulted in the discovery and collection of four new species (Goldblatt 1989; Goldblatt & Manning 1995a), increasing to 85 the number of known species. Further novelties that have accumulated since then include seven species of subgenus *Weihea* (Eckl. ex Baker) Goldblatt and five of subgenus *Geissorhiza*.

In addition, our knowledge of the pollen morphology of *Geissorhiza* has been expanded as a result of examination of pollen grains carried by insects captured after visiting *Geissorhiza* species (Goldblatt & Manning 2000b, 2007). While monosulcate grains with a 2-banded operculum are typical of Crocoideae (Goldblatt *et al.* 1991) and also of *Geissorhiza*, the two species *G. heterostyla* L.Bolus and *G. inflexa* (D.Delaroche) Ker Gawl. (both subgenus *Geissorhiza*

section *Ciliatae* Goldblatt) were found to have pollen grains that depart from the norm in the genus and subfamily. Instead of the single, elliptic aperture, these species have a more complex condition with multiple apertures, described in detail below. Discovery of these striking pollen grains led us to examine a range of species of the genus. Most species of subgenus *Weihea* that we examined have normal grains with a 2-banded operculum as do species of subgenus *Geissorhiza*. However, four new species, *G. cantharophila*, *G. exilis*, *G. saxicola* and *G. reclinata* (all section *Ciliatae*), as well as *G. bracteata* and *G. nana* (section *Weihea*) have grains with complex, multiple apertures. Furthermore, the large-flowered populations of *G. inflexa* (sensu Goldblatt 1985), often with a pink, red or purple perianth, have a different pollen type from those with smaller, white flowers, indicating that they constitute a separate genetic race. For the most part these populations are readily separated from typical *G. inflexa* based on morphology as well as pollen type, and we recognize these plants as a separate species, *G. erosa*. We also include range extensions and morphological notes for *G. arenicola*, *G. divaricata*, *G. heterostyla* and *G. tenella*. With the 12 new species described here and the resurrection of *G. erosa*, *Geissorhiza* now comprises 99 species, all occurring within the Greater Cape Floristic Region (sensu Born *et al.* 2006) with only *G. bracteata* extending outside its confines. We provide new keys to the two subgenera of *Geissorhiza* (Appendix 1), which accommodate all species described since the publication of the last revision of the genus (Goldblatt 1985). The classification of the genus and renumbering of the species is presented in Table 1.

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TABLE 1.—Classification of *Geissorhiza* species arranged by subgenus and section including new species described here, based on Goldblatt’s (1985) infrageneric classification

Subgenus <i>Weihea</i> (Eckl. ex Baker) Goldblatt	
Section <i>Weihea</i> Eckl. ex Baker	Section <i>Includanthera</i> Goldblatt
1. <i>G. inconspicua</i> Baker	29. <i>G. esterhuyensiae</i> Goldblatt
2. <i>G. elsiae</i> Goldblatt	30. <i>G. cedarmontana</i> Goldblatt
3. <i>G. rosealba</i> (G.J.Lewis) Goldblatt	
4. <i>G. outeniquensis</i> Goldblatt	Section <i>Angustifolia</i> Goldblatt
5. <i>G. fourcadei</i> (L.Bolus) G.J.Lewis	31. <i>G. lithicola</i> Goldblatt
6. <i>G. uliginosa</i> Goldblatt & J.C.Manning	32. <i>G. purpurascens</i> Goldblatt
7. <i>G. foliosa</i> Klatt	33. <i>G. humilis</i> (Thunb.) Ker Gawl.
8. <i>G. tricolor</i> Goldblatt & J.C.Manning, sp. nov.	34. <i>G. darlingensis</i> Goldblatt
9. <i>G. nigromontana</i> Goldblatt	35. <i>G. hispidula</i> (R.C.Foster) Goldblatt
10. <i>G. altimontana</i> Goldblatt & J.C.Manning, sp. nov.	36. <i>G. pappei</i> Baker
11. <i>G. delicatula</i> Goldblatt	37. <i>G. intermedia</i> Goldblatt
12. <i>G. monticola</i> Goldblatt & J.C.Manning, sp. nov.	38. <i>G. unifolia</i> Goldblatt
13. <i>G. bracteata</i> Klatt	39. <i>G. juncea</i> (Link) A.Dietr.
14. <i>G. nana</i> Klatt	40. <i>G. furva</i> Ker Gawl. ex Baker
15. <i>G. setacea</i> (Thunb.) Ker Gawl.	41. <i>G. sufflava</i> Goldblatt & J.C.Manning
16. <i>G. lapidosa</i> Goldblatt & J.C. Manning, sp. nov.	42. <i>G. stenosphon</i> Goldblatt
17. <i>G. ornithogaloidea</i> Klatt	
18. <i>G. malmesburiensis</i> R.C.Foster	Section <i>Ixiopsis</i> Goldblatt
19. <i>G. platystigma</i> Goldblatt & J.C.Manning, sp. nov.	43. <i>G. umbrosa</i> G.J.Lewis
20. <i>G. geminata</i> E.Mey. ex Baker	44. <i>G. alticola</i> Goldblatt
21. <i>G. ovalifolia</i> R.C.Foster	45. <i>G. hesperanthoides</i> Schltr.
22. <i>G. bolusii</i> Baker	46. <i>G. cataractarum</i> Goldblatt
23. <i>G. parva</i> Baker	47. <i>G. nubigena</i> Goldblatt
24. <i>G. ovata</i> (L.f.) Asch. & Graebn.	
	Section <i>Engvsiphon</i> (G.J.Lewis) Goldblatt
Section <i>Tortuosa</i> Goldblatt	48. <i>G. helmei</i> Goldblatt & J.C.Manning, sp. nov.
25. <i>G. corrugata</i> Klatt	49. <i>G. brevitiba</i> (G.J.Lewis) Goldblatt
26. <i>G. spiralis</i> (Burch.) M.P.de Vos ex Goldblatt	50. <i>G. schinzii</i> (Baker) Goldblatt
27. <i>G. karooica</i> Goldblatt	51. <i>G. longifolia</i> (G.J.Lewis) Goldblatt
	52. <i>G. confusa</i> Goldblatt
Section <i>Pusilla</i> Goldblatt	53. <i>G. bonaspei</i> Goldblatt
28. <i>G. pusilla</i> (Andrews) Klatt	54. <i>G. tenella</i> Goldblatt
	55. <i>G. exscapa</i> (Thunb.) Goldblatt
Subgenus <i>Geissorhiza</i>	
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56. <i>G. similis</i> Goldblatt	
57. <i>G. scillaris</i> A.Dietr.	Section <i>Planifolia</i> Goldblatt
	79. <i>G. aspera</i> Goldblatt
Section <i>Geissorhiza</i>	80. <i>G. demissa</i> Goldblatt & J.C.Manning, sp. nov.
58. <i>G. imbricata</i> (D.Delaroche) Ker Gawl.	81. <i>G. inaequalis</i> L.Bolus
59. <i>G. purpureolutea</i> Baker	82. <i>G. lewisiae</i> R.C.Foster
60. <i>G. barkerae</i> Goldblatt	83. <i>G. monanthos</i> Eckl.
61. <i>G. louisabolusiae</i> R.C.Foster	84. <i>G. tulbaghensis</i> F.Bolus
62. <i>G. brehmii</i> Eckl. ex Klatt	
63. <i>G. sulphurascens</i> Schltr. ex R.C.Foster	Section <i>Ciliatae</i> Goldblatt
64. <i>G. minuta</i> Goldblatt	85. <i>G. namaquensis</i> W.F.Barker
65. <i>G. eurystigma</i> L.Bolus	86. <i>G. kamiesmontana</i> Goldblatt
66. <i>G. mathewsii</i> L.Bolus	87. <i>G. divaricata</i> Goldblatt
67. <i>G. radians</i> (Thunb.) Goldblatt	88. <i>G. subrigida</i> L.Bolus
	89. <i>G. heterostyla</i> L.Bolus
Section <i>Monticola</i> Goldblatt	90. <i>G. cantharophila</i> Goldblatt & J.C.Manning, sp. nov.
68. <i>G. burchellii</i> R.C.Foster	91. <i>G. reclinata</i> Goldblatt & J.C.Manning, sp. nov.
69. <i>G. grandiflora</i> Goldblatt	92. <i>G. arenicola</i> Goldblatt
70. <i>G. callista</i> Goldblatt	93. <i>G. splendidissima</i> Diels
71. <i>G. tabularis</i> Goldblatt	94. <i>G. inflexa</i> (D.Delaroche) Ker Gawl.
72. <i>G. ramosa</i> Ker Gawl. ex Klatt	95. <i>G. erosa</i> (Salisb.) R.C.Foster
73. <i>G. bryicola</i> Goldblatt	96. <i>G. exilis</i> Goldblatt & J.C.Manning, sp. nov.
74. <i>G. scopulosa</i> Goldblatt	97. <i>G. saxicola</i> Goldblatt & J.C.Manning, sp. nov.
75. <i>G. ciliatula</i> Goldblatt	98. <i>G. erubescens</i> Goldblatt
76. <i>G. pseudinaequalis</i> Goldblatt	99. <i>G. leipoldii</i> R.C.Foster
77. <i>G. rupicola</i> Goldblatt & J.C.Manning	

Lastly, we review what little is known about the floral ecology of *Geissorhiza* and present a range of observations on pollinator visits and nectar characteristics of several species. Available information shows that pollination in the genus is dominated by female bees of the families Andrenidae, Colletidae, Halictidae and Melittidae plus workers of *Apis mellifera* (Apidae), often in combination with hopliine scarab beetles, short-proboscid Tabanidae

and butterflies. The specialized pollination system using one or more species of long-proboscid Nemesitridae and Tabanidae is the second most important system in *Geissorhiza*, confirmed for five species and inferred for three more. Pollination primarily by hopliine scarab beetles is rare, and is reported for the first time in the genus, as are visits by empidid flies (Empididae), and also deceptive pollination by short-proboscid Tabanidae.

MATERIALS AND METHODS

Pollen grains obtained from fresh flowers or from herbarium specimens of a range of species (Table 2) were extracted from anthers with a needle moistened in Calberla's fluid (Ogden *et al.* 1974) and mounted on glass slides in a drop of the same fluid. Preparations were examined after 2–24 hours, by which time the exine is stained a darker colour than the aperture and grain contents. Only two species of the genus were included in a previous survey of pollen types in Crocoideae (Goldblatt *et al.* 1991). Thus, in an effort to determine the extent of the variation in pollen morphology in the genus, we have surveyed a wide range of species belonging to both subgenera and all sections (Table 1).

Nectar volumes were measured using micro tubes, and nectar concentrations were determined with a Bellingham & Stanley refractometer (0–50 %) (Goldblatt *et al.* 2004a; Manning & Goldblatt 2005).

For pollinator observations, insects visiting flowers and seen to contact anthers or stigmatic surfaces were captured and killed using ethyl acetate fumes following methods described by Goldblatt *et al.* (2004a) and Goldblatt & Manning (2007). The identity of pollen carried by captured insects was determined by microscopic examination of samples removed from their bodies using dissecting needles in the same way as described above for sampling from herbarium specimens.

RESULTS

POLLEN MORPHOLGY

Our survey of pollen morphology establishes the presence of the plesiomorphic type pollen grains reported in our earlier survey of Crocoideae (Goldblatt *et al.* 1991) as the most common type in the genus (Table 2). These grains are monosulcate with tectate-perforate exine bearing small supratectal spinules. The sulcus field is largely smooth apart from a pair of narrow exine bands (elongated opercula), lying parallel to one another along the long axis of the aperture (Figure 1A). Often there is also a sprinkling of exine material lying in the centre of the three apertural zones defined by the opercular bands. One species of subgenus *Weihea*, *G. parva*, has poorly developed operculum bands, represented merely by two sparsely beaded lines of exine.

Two species of subgenus *Weihea*, among those examined, and four of subgenus *Geissorhiza* have grains of remarkably different appearance (Table 2). In contrast to the majority of species in the genus, *Geissorhiza cantharophila*, *G. exilis*, *G. inflexa*, *G. reclinata*, *G. saxicola* and most populations of *G. heterostyla* (subgenus *Geissorhiza* section *Ciliatae*) and *G. bracteata* and *G. nana* (subgenus *Weihea* section *Weihea*) have grains that depart radically from the standard type. Grains have typical tectate-perforate exine, but have more complex apertures. The \pm orbicular and slightly larger grains of *G. bracteata*, *G. cantharophila*, *G. nana* and some populations of *G. heterostyla* have two discrete apertures, a smaller elliptic one surrounded by a broad band of exine (? or operculum) lying within a larger \pm elliptic or cir-

cumferential sulcus (Figure 1B). We interpret this grain as derived from the basic type in which the two bands of the operculum have become wider and longer and their ends have fused, leaving an island of enclosed apertural membrane within the operculum. The aperture surrounding this structure may also be elliptic or continuous around the grain, leaving the non-apertural part of the grain as two separate pieces of exine. Curiously, six populations of *G. heterostyla* examined (Table 2), all from the north of its range, have normal grains with a 2-banded operculum. We have re-examined these collections and find no taxonomically significant difference between them and the more common *G. heterostyla*. One of the collections with normal type pollen grains (Goldblatt 6216 MO) even consists of the mixture of short- and long-styled plants that is currently understood to be unique to this species.

Some populations of *Geissorhiza inflexa* have *G. heterostyla*-type grains (Figure 1B; Table 2) but in others the grains have five or six bands of exine running across the grain separated by apertures of about the same width (Figure 1C). The bands merge at one pole so that in this view five or six elliptic zones of apertural membrane are visible, whereas viewed at right angles, the apertures run the length of the grain separated by long bands of exine. At the opposite end the exine bands do not quite fuse but adjacent bands fuse toward their tips. All the large-flowered populations of *G. inflexa*, with either red, pink, purple or white flowers have this apertural pattern. These large-flowered colour morphs were included in *G. inflexa* by Goldblatt (1985) without infraspecific recognition.

A last variant is the plant described here as *Geissorhiza reclinata*, which has pollen grains with two large horse-

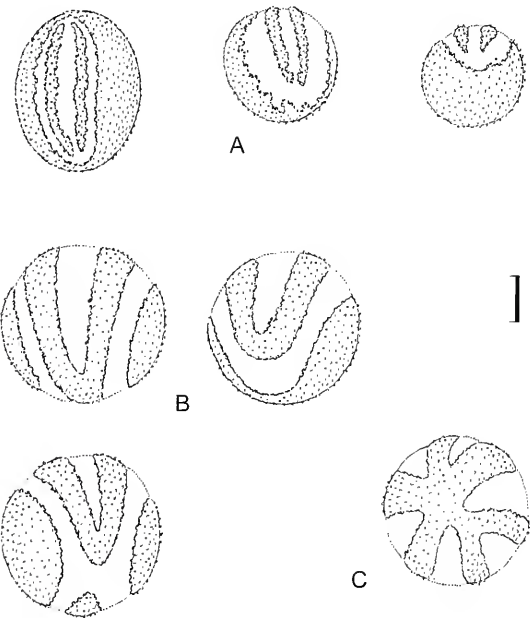


FIGURE 1.—Pollen grains of *Geissorhiza* species. A, *G. arenicola*, Goldblatt & Manning 9465 (NBG); B, *G. heterostyla*, Goldblatt & Porter 12185 (NBG); C, *G. erosa*, Helme 2247 (NBG). Scale bar: 200 μ m.

TABLE 2.—Pollen types in *Geissorhiza* species arranged by subgenus according to Goldblatt’s (1985) infrageneric classification. Herbaria are abbreviated following Holmgren *et al.* (1990)

Taxon	Collection data and herbarium acronym or literature reference
Grains monosulcate with two-banded operculum	
Subgenus <i>Weilhea</i>	
Section <i>Weilhea</i>	
<i>G. foliosa</i> Klatt	<i>Goldblatt & Manning 10783</i> (MO)
<i>G. inconspicua</i> Baker	<i>Goldblatt & Nänni 11580</i> (MO)
<i>G. monticola</i> Goldblatt & J.C.Manning	<i>Goldblatt & Porter 11872</i> (MO, NBG)
<i>G. ornithogaloides</i> Klatt	<i>Goldblatt & Nänni 11197</i> (MO), <i>Goldblatt 11467</i> (MO)
<i>G. ovata</i> (L.f.) Asch. & Graebn.	no voucher
<i>G. parva</i> Baker	<i>Goldblatt & Porter 12266</i> (MO) (operculum vestigial)
Section <i>Angustifolia</i>	
<i>G. juncea</i> (Link) A.Dietr.	<i>Goldblatt 11554</i> (MO)
<i>G. aff. pappei</i> Baker	<i>Goldblatt & Manning 9944</i> (MO, NBG)
<i>G. purpurascens</i> Goldblatt	<i>Goldblatt & Manning 11560</i> (MO, NBG)
<i>G. sufflava</i> Goldblatt & J.C.Manning	<i>Goldblatt & Manning 9468</i> (MO, NBG)
Section <i>Isiopsis</i>	
<i>G. nubigena</i> Goldblatt	<i>Goldblatt 10608</i> (MO)
Section <i>Engysiphon</i>	
<i>G. bonaspei</i> Goldblatt	<i>Goldblatt 11640</i> (MO)
<i>G. confusa</i> Goldblatt	<i>Goldblatt & Manning 10119</i> (MO)
<i>G. exscapa</i> (Thunb.) Goldblatt	<i>Goldblatt & Manning 10346</i> (MO)
<i>G. longifolia</i> (G.J.Lewis) Goldblatt	<i>Goldblatt & Manning 11486</i> (MO); <i>Oliver 4070</i> (NBG)
<i>G. schinzii</i> (Baker) Goldblatt	<i>Goldblatt et al. (1991)</i>
<i>G. tenella</i> Goldblatt	<i>Goldblatt & Manning 10376</i> (MO)
Subgenus <i>Geissorhiza</i>	
Section <i>Ciliatae</i>	
<i>G. divaricata</i> Goldblatt	<i>Goldblatt 10291</i> (NBG)
<i>G. eribescens</i> Goldblatt	<i>Compton 19964</i> (NBG)
<i>G. heterostyla</i> L.Bolus	<i>Goldblatt 6261, 5305, 5824</i> (MO); <i>Goldblatt & Manning 10293</i> (MO); <i>Goldblatt & Porter 12770</i> (MO), <i>12822</i> (MO, NBG)
<i>G. leipoldtii</i> R.C.Foster	<i>Van Rooyen et al. 718</i> (NBG)
<i>G. namaquensis</i> W.F.Barker	<i>Goldblatt & Manning 9705</i> (NBG)
<i>G. subrigida</i> L.Bolus	<i>Lewis 5886</i> (NBG)
Section <i>Geissorhiza</i>	
<i>G. barkerae</i> Goldblatt	<i>Goldblatt 6391</i> (NBG)
<i>G. eurystigma</i> L.Bolus	no voucher
<i>G. lonisabolusiae</i> R.C.Foster	<i>Goldblatt & Porter 12605</i> (MO)
<i>G. purpureoheutea</i> Baker	<i>Goldblatt & Manning 11139</i> (NBG)
<i>G. radians</i> (Thunb.) Goldblatt	<i>Goldblatt et al. (1991)</i> ; <i>Van Zyl 3512</i> (NBG)
<i>G. sniphurascens</i> Schltr. ex R.C.Foster	<i>Snijman 896</i> (NBG); <i>Goldblatt & Manning 9465</i> (NBG)
Section <i>Intermedia</i>	
<i>G. scillaris</i> A.Dietr.	<i>Goldblatt et al. (1991)</i>
Section <i>Monticola</i>	
<i>G. bryicola</i> Goldblatt	<i>Williamson 3683</i> (NBG)
<i>G. burchellii</i> R.C.Foster	<i>Williams 3754</i> (NBG)
<i>G. callista</i> Goldblatt	<i>Goldblatt 8680</i> (NBG)
<i>G. grandiflora</i> Goldblatt	<i>Oliver & Oliver 11468</i> (NBG)
<i>G. pseudinaequalis</i> Goldblatt	<i>Manning 2220</i> (NBG)
<i>G. ramosa</i> Ker Gawl. ex Klatt	<i>Esterhuysen 36144</i> (NBG), <i>33703</i> (MO)
<i>G. silenoides</i> Goldblatt & J.C.Manning	<i>Goldblatt & Manning 9739</i> (NBG)
Section <i>Planifolia</i>	
<i>G. arenicola</i> Goldblatt	<i>Goldblatt & Nänni 11154</i> (NBG); <i>Goldblatt & Porter 11888A</i> (NBG)
<i>G. aspera</i> Goldblatt	<i>Goldblatt & Manning 9403</i> (NBG)
<i>G. inaequalis</i> L.Bolus	<i>Goldblatt & Porter 11795</i> (NBG)
<i>G. monanthos</i> Eckl.	<i>Beyers 77</i> (NBG); <i>Goldblatt & Nänni 11553</i>
<i>G. splendidissima</i> Diels	<i>Barker 9549</i> (NBG)
<i>G. mlbaghensis</i> F.Bolus	<i>Solomon 38</i> (NBG)
Grains with complex multiple apertures	
Type 1 grains: two elliptic apertures, smaller nested in larger; type 2: more complex apertures described in text	
Subgenus <i>Weilhea</i>: section <i>Weilhea</i>	
<i>G. bracteata</i> Klatt	type 1: <i>Goldblatt & Porter 12358A</i> (MO); <i>Goldblatt & Porter 12714</i> (MO, NBG)
<i>G. nano</i> Klatt	type 1: <i>Goldblatt & Manning 12255</i> (MO)

TABLE 2.—Pollen types in *Geissorhiza* species arranged by subgenus according to Goldblatt’s (1985) infrageneric classification. Herbaria are abbreviated following Holmgren *et al.* (1990) (cont).

Subgenus <i>Geissorhiza</i>: section <i>Ciliatae</i>	
<i>G. saxicola</i> Goldblatt & J.C.Manning	type 1: Goldblatt & Manning 9094 (MO)
<i>G. cantharophila</i> Goldblatt & J.C.Manning	type 1: Hanekom 1562 (MO); Manning 2797 (NBG); Goldblatt & Porter 12704 (MO, NBG)
<i>G. heterostyla</i> L.Bolus	type 1: Goldblatt 6203 (MO); Goldblatt & Porter 12185, 12328, 12791, 12937,12942 (MO); Goldblatt & Manning 12174 (MO); Oliver 9643 (NBG); Snijman 734 (NBG)
<i>G. inflexa</i> (D.Delaroche) Ker Gawl.	type 1: Boucher 5439 (NBG); Goldblatt 2497, 3996, 6203 (MO) (small white-flowered plants) type 2: Goldblatt 2497, 11422A; 11426, 12995 (MO); Goldblatt & Manning 12687 (MO); Helme 2247 (NBG)
<i>G. exilis</i> Goldblatt & J.C.Manning	type 1: Goldblatt & Manning 13041 (MO, NBG)
<i>G. reclinata</i> Goldblatt & J.C.Manning	type 2: Goldblatt & Porter 12057 (MO, NBG)

shoe-shaped bands of exine oriented at right angles to one another and thus one large sulcus of irregular shape.

Pollen grains with a 2-banded operculum are not universal in Crocoideae but are the only type known in 16 of the 29 genera recognized in the subfamily (Goldblatt *et al.* 1991). Exceptions are: 1, *Ixia* and *Xenoscapa*, one species of *Freesia*, section *Fastigiata* of *Lapeirousia*, a few species of *Romulea*, and several of *Thereianthus*, which have a 1-banded operculum (Goldblatt & Manning 1995b); 2, *Syringodea* and some species of *Crocus*, which have inaperturate grains (e.g. De Vos 1974); 3, *Cyanixia* and *Zygotritonia*, which have trisulcate grains (Goldblatt *et al.* 2004b); 4, *Savannosiphon*, which has polyaperturate pollen grains (Goldblatt *et al.* 1991); 5, *Afroccrocus*, which has trizonosulcate grains; and 6, *Micranthus*, which has zonosulcate grains with the exine reticulate except close to the aperture where the sculpturing grades from microreticulate to perforate immediately adjacent to the aperture margin (Goldblatt *et al.* 1991, and unpublished data).

The discovery of unusual pollen grains in two species of section *Weihea* of subgenus *Weihea* and several of section *Ciliatae* of subgenus *Geissorhiza* represents another significant departure from the standard type in Crocoideae and a striking specialization within the genus. The presence of divergent pollen types in *Geissorhiza* is most parsimoniously viewed as evidence for a close relationship of the species of each subgenus that share the character even though the precise morphology of the apertures may differ. *G. heterostyla* and *G. inflexa* are already believed to be closely related on account of their similar, derived leaf blades (Goldblatt 1985), and *G. exilis* shares a similar vegetative morphology (Goldblatt 1985). A fourth species with this pollen type, *G. cantharophila*, until now included in *G. heterostyla*, is obviously immediately related to that species. The appearance of normal-type pollen grains in the six northernmost populations sampled of *G. heterostyla* (Langberg to Hantamsberg and Bokkeveld Mountains) is surprising. No feature sets them apart in the genus and all that can be concluded at present is that the variation has a geographic component. Variation in pollen grain morphology within a species is surprising since pollen and seed morphology are widely believed to be highly conservative. Variation even within a genus on such a scale as reported here is unexpected. In section *Weihea*, *G. bracteata* and *G. nana* share similar divergent pollen grains, which supports Goldblatt’s (1985) inference based on morphology that they are immediately allied.

The broader significance of the divergent pollen grains is uncertain. None of the species seem particularly unusual morphologically in *Geissorhiza*. Two of them, *G. inflexa* and *G. heterostyla* have what may be termed a generalist pollination system that includes female bees and *Apis mellifera* workers, hopline beetles, and occasionally butterflies, a pattern encountered widely in *Geissorhiza* (see below). *Geissorhiza cantharophila* is adapted for pollination by hoplines, three species of which have been captured on the flowers.

Another issue concerns the significance at the taxonomic level of the grains of the large-flowered ‘*Geissorhiza erosa*’ populations of *G. inflexa*, which have 5 (or 6) apertures. The justification for the reduction of this taxon in *G. inflexa* by Goldblatt (1985) was the presence in *G. inflexa sensu lato* of populations with larger than usual, pink or purple flowers that seemed to link the typical and common form of *G. inflexa*, which has moderate-sized, white flowers, with the large-flowered *G. erosa* with its brilliant scarlet perianth. In the light of the consistent association of this different pollen with large, white, pink or red-flowered plants we conclude that the larger-flowered plants constitute a separate genetic race and we re-evaluate their taxonomic status below.

SYSTEMATICS

The new species are arranged numerically within subgenera. Their position and number in the classification of *Geissorhiza* is given in Table 1.

Subgenus *Weihea* (Eckl. ex Baker) Goldblatt

8. *Geissorhiza tricolor* Goldblatt & J.C.Manning, sp. nov.

Plantae 100–150(–200) mm altae, corno globoso 5–6 mm diam. tunicis concentricis lignosis duris, foliis 6 ad 8 erectis vel falcatis 15–50 × (2–)3–5 mm planis, caule erecto simpliciter vel 1- vel 2-ramoso, spica (1)2- vel 3-flora, bracteis viridibus distaliter rubro-suffusis (12–) 15–18 mm longis, floribus actinomorphae rotatis aureis ad centrum atomarroninis nitidis ad tubum flavoviridibus inodoris 30–38 mm diam., tubo perianthii 3–4 mm longo, tepalis late obovato-quadratis 15–18 mm longis, filamentis atomarroninis ± 3 mm longis, antheris sub anthesi ± 5 mm longis, stylo excentrico ± 6 mm longo ramis 2.5–3.0 mm longis.

TYPE.—Western Cape, 3421 (Riversdale): Werner Frehse Nature Reserve, south of N2, east of Riversdale,

pebbly ferricrete in renosterveld-fynbos transitional vegetation, (–AB), 6 October 2006, *Manning 3071* (NBG, holo.; MO, PRE, iso.).

Plants 100–150(–200) mm high, with pale membranous cataphylls. *Corn* obliquely globose, asymmetric and flattened slightly below on one side, 5–6 mm diam., tunics concentric, brown, hard and woody, fragmenting irregularly into sections. *Stem* erect, simple or 1- or 2-branched, either from base or from upper stem nodes. *Leaves* 6–8, lower 4 or 5 basal and largest, lanceolate to sword-shaped, short and mostly less than one third as long as stem, 15–50 × (2–)3–5 mm, upper decreasing progressively in size, uppermost bract-like and often without blade. *Spike* (1)2- or 3-flowered; bracts green, flushed reddish distally, elliptic, (12–)15–18 mm long, subequal, inner not notched apically. *Flowers* rotate, golden yellow with glossy blackish maroon eye covering basal quarter of tepals, yellowish green in tube, outer tepals flushed reddish on reverse, unscented, 30–38 mm diam.; perianth tube funnel-shaped, 3–4 mm long; tepals broadly obovate-quadrate, margins irregularly crenulate in distal half, 15–18 mm long, outer 10–11 mm wide, inner 12–14 mm wide. *Stamens*: filaments ± 3 mm long, exserted for ± 1 mm, dark maroon; anthers ± 5 mm long at anthesis, pollen yellow. *Ovary* obovoid, 5 mm long; style eccentric, ± 6 mm long, dark maroon, exserted for ± 1 mm, dividing opposite lower half of anthers, style branches 2.5–3.0 mm long. *Capsules* and *seeds* unknown. *Flowering time*: September and early October; flowers opening between mid-morning and early afternoon. Figure 2.

Eponymy: from the Latin, *tricolor*, three-coloured, for the golden yellow flower with a maroon central eye and pale yellow in the throat and tube.

Distribution and ecology: *Geissorhiza tricolor* apparently has a very limited range southeast of Riversdale in southern Western Cape (Figure 3). The largest population occurs in the small Werner Frehse Nature Reserve a few kilometres east of Riversdale, where it is protected from disturbance. Plants grow in pebbly ironstone at the transition between renosterveld and fynbos-thicket.

Diagnosis and relationships: according to available records *Geissorhiza tricolor* was discovered in September 2006 during a botanical survey of the site of a new housing development at Riversdale. A collection made by N.A Helme alerted us to the existence of the plant, which we re-collected in early October. The species is unique in *Geissorhiza* in its deep yellow flowers with exceptionally broad tepals and a dark, maroon-black central eye. The perianth tube is very short in comparison, 3–4 mm long. The species recalls *G. inconspicua* and *G. foliosa* in vegetative morphology but the flowers are larger than in both of these species and very different in coloration. *Geissorhiza foliosa* has pink to light purple flowers with a tube ± 5 mm long and tepals 13–17 mm long, and *G. inconspicua* has blue-violet, pink or white flowers with a perianth tube 4–6 mm long and tepals 8–11, rarely up to 15 mm long.

The flowers of *Geissorhiza tricolor* closely resemble those of orange-flowered *Ornithogalum dubium* which blooms together with it in the Werner Frehse Nature Reserve and we assume that both species are pollinated

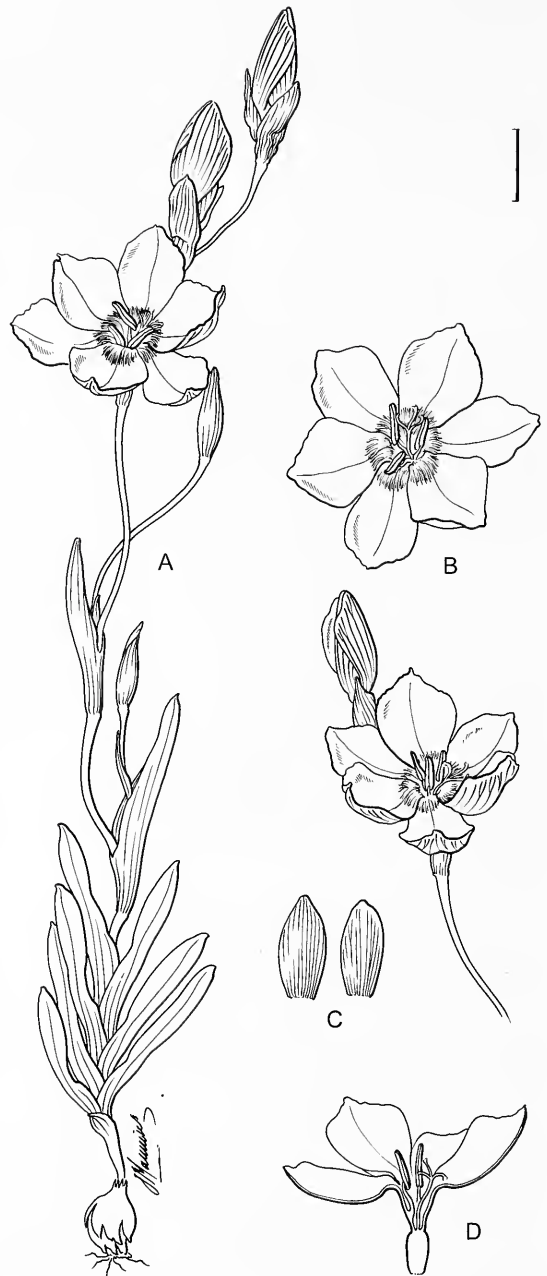


FIGURE 2.—*Geissorhiza tricolor*, Manning 3071 (NBG). A, flowering plant; B, flowers; C, outer (left) and inner (right) floral bracts; D, half-flower. Scale bar: 10 mm. Artist: J.C. Manning.

by the same suite of hopliine beetles. No hopliines or other potential pollinators have so far been recorded on *G. tricolor* or *O. dubium* at that locality but the latter species has been found to be pollinated by hopliine beetles at other sites (Goldblatt *et al.* 1998).

Additional specimens examined

WESTERN CAPE.—3421 (Riversdale): southern edge of Riversdale, Rooidam, east of N2, stony well-drained loam, in renosterveld, (–AB), 22 September 2006, *Helme 4193* (NBG).

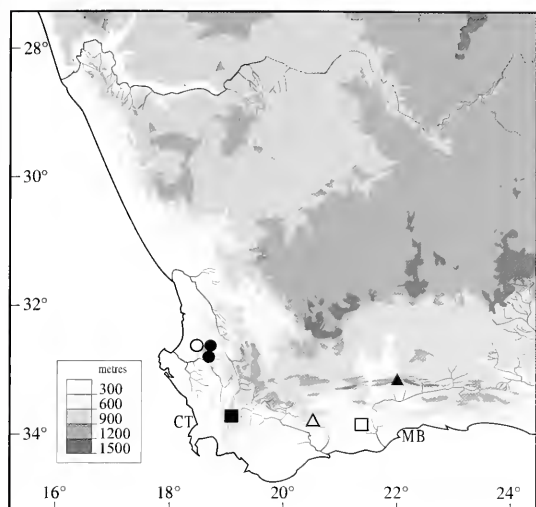


FIGURE 3.—Known distribution of *Geissorhiza altimontana*, Δ ; *G. helmei*, \circ ; *G. monticola*, \blacktriangle ; *G. sufflava*, \bullet ; *G. tricolor*, \square ; *G. lapidosa*, \blacksquare .

10. *Geissorhiza altimontana* Goldblatt & J.C.Manning, sp. nov.

Plantae 60–120 mm altae, cormo tunicis manifeste concentricis, foliis 5 vel 6, 4 inferioribus basalibus prostratis lanceolatis 20–50 \times 2.5–6.0 mm, spica 1- vel 2-flora, bracteis viridibus ad apicem rubris 7–10 mm longis, floribus actinomorpha carneis, perianthii tubo 7–8 mm longo \pm cylindrico, tepalis subaequalibus oblongis \pm 14 \times 6 mm, filamentis \pm 8 mm longis aequalibus, antheris \pm 4 mm longis, ramis styli recurvatis \pm 1.3 mm longis.

TYPE.—Western Cape, 3320 (Montagu): Langeberg, upper slopes of Leeuriviersberg, 300 m east of peak, 1 550 m, (–CD), 15 January 2006, *Helme* 3778 (NBG, holo.).

Plants 60–120 mm high including flowers, stem base sheathed underground by a collar of dry, persistent leaf bases, and above ground by dry cataphylls. *Corm* ovoid, 4–6 mm diam., tunics soft-textured, light brown, evidently concentric, becoming fibrous and not accumulating with age. *Stem* erect or sometimes horizontal at ground level for a short distance, unbranched, smooth. *Leaves* 5 or 6, lower 4 basal, spreading horizontally and \pm prostrate, blades lanceolate, leathery, 20–50 \times 2.5–6.0 mm, margins moderately thickened, cauline leaves 1 or 2, shorter than basal leaves and sheathing for half their length. *Spike* erect, \pm straight, 1- or 2-flowered; bracts green with red tips, 7–10 mm long, outer obtuse, inner notched apically. *Flowers* radially symmetric with tepals ascending, pink but \pm greenish in throat, unscented; perianth tube \pm cylindric, 7–8 mm long; tepals subequal, oblong, \pm 14 \times 6 mm, ascending and forming a wide cup. *Stamens*: filaments \pm 8 mm long, equal; anthers \pm 4 mm long, sagittate at base for \pm 1 mm, yellow, pollen yellow. *Ovary* ovoid, \pm 2.5 mm long; style slender, dividing opposite anther apices, style branches slightly recurved and arching over anthers, \pm 1.3 mm long. *Capsules* and *seeds* unknown. *Flowering time*: January. Figure 4.

Eponymy: from Latin *alti*, high, *montanus*, mountains, referring to the habitat.

Distribution and ecology: known from just one collection on Leeuriviersberg (Grootberg) west of Swellendam, *Geissorhiza altimontana* occurs at high elevations in the Langeberg at \pm 1 550 m (Figure 3). Plants were collected in unburned veld, growing on damp, mossy ledges on steep, south-trending slopes. The area is exposed to frequent summer cloud from southeast trade winds, making flowering of this soft geophyte possible in a region of predominantly summer drought.

Diagnosis and relationships: with its five or six, relatively short leaves, the basal leaves spreading horizontally, the short stature and 1- or 2-flowered spikes, *Geissorhiza altimontana* appears most closely allied to the Swartberg species, *G. nigromontana* Goldblatt and *G. uliginosa* Goldblatt & J.C.Manning. *Geissorhiza uliginosa* is essentially aquatic, growing in streams and waterfalls, and has reduced corms but *G. nigromontana* has a similar habitat to *G. altimontana*: damp, mossy ledges in shallow soil and south-facing slopes, and both species flower in the summer months of January and February. The longer perianth tube, 7–8 mm long, and tepals \pm 14 mm long, readily separate *G. altimontana* from *G. nigromontana*, which has a very short perianth tube, 2–3 mm long, and longer tepals, 14–16 mm long.

12. *Geissorhiza monticola* Goldblatt & J.C.Manning, sp. nov.

Plantae 100–160 mm altae, cormo globoso \pm 10 mm diam. tunics concentricis atrobrunneis, foliis 4–7 inferioribus 2 vel 3 basalibus linearibus vel falcatis patentibus vel prostratis, caule filiformi flexuoso usque ad 4-ramoso, spica 1-flora, bracteis viridibus purpureo-suffusis 8–10 mm longis marginibus membranaceis, floribus zygomorpha caeruleo-malvinis, perianthii tubo infundibuliformi \pm 3 mm longo leviter curvato, tepalis anguste oblongis obtusis patentibus 14–18 \times 4.0–5.5 mm, filamentis unilateralibus declinatis 7–9 mm longis, antheris 3–4 mm hebetate roseis, stylo prope antherarum apices diviso ramis 3–4 mm longis recurvatis.

TYPE.—Western Cape, 3321 (Ladismith): Swartberg, road to Gamkakloof, (–BD), 10 September 2001, *Goldblatt & Porter* 11872 (NBG, holo.; MO, iso.).

Plants 100–160 mm high. *Corm* globose, asymmetric with oblique, flattened side, \pm 10 mm diam., tunics concentric, dark brown, fragmenting into vertical sections. *Stem* filiform, flexuose, with up to four, 1-flowered branches from axils of cauline leaves. *Leaves* 4–7, soft-textured, lower 2 or 3 basal and \pm half as long as stem, spreading to prostrate, blades linear to falcate, plane with slightly thickened and raised central vein, 2–3 mm wide, upper leaves cauline, decreasing in size upward, partly to entirely sheathing. *Inflorescence*: flowers solitary on branches; bracts green, soft, flushed purple, margins membranous, transparent, 8–10 mm long, inner slightly shorter than outer. *Flowers* zygomorphic, facing to side with tepals held vertically, blue-mauve with greenish cream throat edged with dark blue; perianth tube funnel-shaped, slightly curved, \pm 3 mm long; tepals narrowly oblong, obtuse, spreading at right angles to tube, 14–18 \times 4.0–5.5 mm, inner slightly narrower than outer. *Stamens* unilateral and declinate; filaments 7–9 mm long, exerted for 7–8 mm; anthers 3–4 mm long, dull pink.



FIGURE 4.—*Geissorhiza altimontana*, Helme 3778 (NBG).

Ovary ± 3.5 mm long; style dividing near apex of anthers, style branches 3–4 mm long, recurved. Capsules and seeds unknown. Flowering time: September. Figure 5.

Eponymy: from Latin, meaning growing in the mountains.

Distribution and ecology: the only known population of *Geissorhiza monticola* is from the central Swartberg, west of Swartberg Pass (Figure 3). Plants grow on south-trending, rocky sandstone slopes in pockets of peaty sand.

Diagnosis and relationships: *Geissorhiza monticola* is distinguished by solitary flowers with large, blue, zygomorphic flowers facing to the side, very short perianth tube and well-exserted, declinate stamens. Its relationships presumably lie with *G. delicatula* Goldblatt of the Langeberg and Swartberg and its allies, with which it shares an oblique corm, several plane leaves with the marginal vein set slightly away from the margin itself, herbaceous bracts, and solitary flowers. *Geissorhiza delicatula*, known to us only from dried specimens, has much smaller, cup-shaped



FIGURE 5.—*Geissorhiza monticola*, Goldblatt & Porter 11872 (NBG).

flowers that are held upright, with elliptical or obovate, pale mauve tepals mostly 7–10 mm long, erect stamens with filaments 3–5 mm long, and a central style of similar length with short style branches up to 1.5 mm long, thus less than half as long as in *G. monticola*. *Geissorhiza nigromontana* may also be confused with *G. monticola* but it has a stem ± prostrate toward the base, a spike of 2 or 3 flowers (flowers always in *G. monticola*), bears cormlets in the leaf axils, shorter leaves with blades 4–10 mm wide (vs 2–3 mm in *G. monticola*) and the flowers are, as far as known (Goldblatt 1985), upright and radially symmetric.

The flowers of *Geissorhiza monticola* bear a remarkable similarity to those of *G. grandiflora* in their orientation, shape, and in the well-exserted, declinate stamens and style

but this similarity is presumably due to convergence. *G. grandiflora* from the southwestern coastal mountains has leaves with prominently thickened margins and main vein, and is thus 2-grooved on each surface, has (1–)3–8-flowered spikes, and longer floral tubes, 10–22 mm long.

16. *Geissorhiza lapidosa* Goldblatt & J.C.Manning, sp. nov.

Plantae ± acaulescentes 20–40 mm altae eramosae, cormo 4–5 mm diam., tunicis concentricis lignosis nigrescentibus, foliis 4 laminis lineari-falcatis crassis coriaceis glaucis marginibus saepe rubrescentibus ad 50 × 0.5–1.0 mm, folio supremo vaginanti, spica 1- vel 2-flora, bracteis coriaceis glaucis ovatis bractea exteriori 4–5 mm longa, interiori ad apicem furcata, floribus



FIGURE 6.—*Geissorhiza lapidosa*, Helme & Turner 5747 (NBG), whole plants. Scale bar: 10 mm. Artist: J.C. Manning.

actinomorpha albis tepalis exterioribus extus rubro-carneis, tubo perianthii infundibuliformi 2.0–2.5 mm longo, tepalis patentibus oblanceolatis $\pm 6 \times 2$ mm, filamentis 3.5–4 mm longis, antheris 1.5–2.0 mm longis \pm albis, stylo dimidium inferiorem antherarum adversum divisio, ramis 1.5–2 mm longis.

TYPE.—Western Cape, 3319 (Worcester): Du Toitskloof Mtns, Goudini Sneekop, western and southern edges of shale band, 1 700–1 730 m, seasonally damp, shallow moss and shale-derived silt overlying sandstone shelf, rare and localized, (–CC), 9 November 2008, Helme & Turner 5747 (NBG, holo.).

Plants \pm acaulescent, 20–40 mm high, unbranched with stem smooth, flushed red, not or barely extending above ground. *Corm* obliquely ovoid with narrow flat side, 4–5 mm diam., tunics woody, dark, blackish, concentric. *Leaves* 4, lower two basal, third leaf inserted at or shortly above ground, blades linear-falcate, exceeding the spike, 0.5–1.0 mm wide, thick and leathery, elliptical in section when fresh, glabrous, glaucous with margins often reddish, uppermost leaf cauline and bladeless. *Spike* 1- or 2-flowered; bracts leathery and glaucous flushed reddish but submembranous and finely flecked with brownish red along margins, broadly ovate, outer truncate or obscurely trispiculate, 4–5 mm long, inner as long or slightly shorter, notched at apex. *Flowers* actinomorphic, white with outer tepals reddish pink on reverse; perianth tube funnel-shaped, 2.0–2.5 mm long; tepals subequal, oblanceolate, $\pm 6 \times 2$ mm. *Stamens* with filaments 3.5–4.0 mm long, white; anthers 1.5–2.0 mm long, \pm white. *Ovary* obovoid, ± 2.5 mm long; style displaced to one side, dividing opposite lower half of anthers, ± 4 mm long, branches long and recurved, 1.5–2.0 mm long. *Capsules* and *seeds* unknown. *Flowering time*: November. Figure 6.

Eponymy: from the Latin, *lapidosus*, stony or rocky, for the habitat.

Distribution and ecology: known from two small colonies below the shale band on Goudini Sneekop in the Du Toitskloof Mtns (Figure 3). Plants are localized along a narrow band of sandstone pavement at the edge of cliffs where they occur in moist seepages draining from a shale sponge overlying the sandstone, a very restricted habitat less than 4 m wide, where the shale band meets the underlying sandstone. The two colonies seen are about 800 m apart. The area regularly has a snow cover in winter and spring.

Diagnosis and relationships: the oblique corm with concentric tunics and smooth, \pm plane, falcate leaves with the uppermost clearly cauline, place the dwarf *Geissorhiza lapidosa* in section *Weihea* of subgenus *Weihea*. It is distinguished from similar small species of the section by its high montane habit and unusual leathery, falcate leaves at most 1 mm wide. Particularly distinctive are the short-tubed, white flowers with the outer tepals flushed reddish pink and the short style, which branches opposite the lower half of the anthers. The style is eccentric, typical of the genus, as are the recurved style branches, ± 2 mm long. Similar, bicoloured flowers are found in *G. nana* and *G. setifolia*, both lowland species: *G. nana* occurs in renosterveld vegetation in the Overberg between Caledon and Riversdale and has broader, thin-textured leaves 1–2 mm wide and even smaller flowers with the tepals mostly 3–6 mm long, and very short stamens with filaments ± 2 mm long; *G. setifolia* grows in seasonally wet places on flat sandy or loamy ground in Western Cape between Gouda and Caledon and has similarly narrow but linear leaves, 0.5–1(–2) mm wide but larger flowers with tepals 6–8 mm long, a longer tube ± 6 mm long, and the style branching at the tips of the anthers. Other similar species in the group have plain white, mauve or purple flowers and generally broader leaves.

19. *Geissorhiza platystigma* Goldblatt & J.C. Manning, sp. nov.

Plantae 25–50 mm altae, cormo campanulato basi ad marginem dentato ± 3 mm diam., foliis linearibus ± 1 mm latis, caule usitate prope basin 1- vel 2-ramoso, floribus actinomorpha flavis, tubo perianthii ± 1.5 mm longo infundibuliformi, tepalis anguste ovatis $6\text{--}7 \times \pm 3$ mm, filamentis ± 2 mm longis, antheris ± 1.5 mm longis, ramis styli ± 1.5 mm longis prominenter villosis.

TYPE.—Western Cape, 3318 (Cape Town): gravelly, gently north-facing slopes in Darling Nature Reserve, (–AC), 22 September 1999, Goldblatt & Nänni 11162A (NBG, holo.; MO, iso.).

Plants 25–50 mm high. *Corm* bell-shaped, ± 3 mm diam. at widest, basal margin toothed, tunics light brown, concentric, woody. *Stem* usually 1- or 2-branched from near base. *Leaves* linear, ± 1 mm wide, sheaths inflated, plane, \pm as long as stem. *Main and lateral spikes* 1-flowered; bracts green or flushed purple distally, outer ± 8 mm long, inner ± 6 mm long, not forked at apex. *Flowers* actinomorphic, upright, pale yellow, unscented; perianth tube funnel-shaped, ± 1.5 mm long; tepals narrowly ovate, $6\text{--}7 \times \pm 3$ mm. *Stamens* erect, equal; filaments \pm

2 mm long; anthers ± 1.5 mm long, pale yellow. *Ovary* with style erect, dividing opposite upper third of anthers, style branches recurved, ± 1.5 mm long, bearing prominent hairs longer than width of branch. *Capsules* barrel-shaped, ± 5 mm long. *Seeds* \pm globose, slightly less than 1 mm diam. *Flowering time*: September, probably also in late August. Figure 7.

Eponymy: from the Greek, *platy*, broad, for the unusually broad style branches.

Distribution and ecology: known only from the Darling Nature Reserve in the hills above Darling in Western Cape (Figure 8), *Geissorhiza platystigma* grows in granite-derived soils on east- and north-trending slopes. The diminutive plants are found locally in open ground or in the shade of low shrubs in *Elytropappus*-dominated renosterveld.

Diagnosis and relationships: *Geissorhiza platystigma* is one of the most inconspicuous species in the genus. Each branch of the stem is just 30–50 mm high and bears a single flower. Most distinctive are the style branches, which are short and broad and densely covered in prominent hairs much longer than the width of the style branch. The flowers are otherwise unremarkable. The corn closely resembles that of *G. ornithogaloides* subsp. *ornithogaloides* in its bell shape with flat base and sharply dentate lower margin. Seemingly immediately allied to this common species of the coastal and interior of southern Cape. *G. platystigma* differs from it in flower size. *Geissorhiza ornithogaloides* has a perianth tube 2–3(–4) mm long, tepals (6)–7–12(–18) mm long, much larger anthers 3.0–4.5 mm long, and the style branches are slender, 2–3 mm long, and thread-like as is typical of the genus. The short, broad and densely hairy style branches of *G. platystigma* recall those of two other species of the genus from the Darling–Malmesbury area of Western Cape, *G. mathewsii* and *G. eurystigma*, both members of subgenus *Geissorhiza*. The presence of unusual style branches in three species of the genus in this small part of its range seems to be an unusual coincidence unrelated to its pollination system in view of the very different floral morphology of *G. platystigma* compared to larger, blue and red perianth of *G. eurystigma* and *G. mathewsii*.

Additional specimens examined

WESTERN CAPE.—3318 (Cape Town): gravelly slopes in Darling Nature Reserve, (–AC), 3 September 1999, Littlewort s.n. (MO), 12 September 2008, Goldblatt & Porter 13202 (MO, NBG).

41. *Geissorhiza sufflava* Goldblatt & J.C.Manning, sp. nov.

Plantae 100–150 mm altae foliis exclusis, cormo globoso ± 8 mm diam., tunicis pallide brunneis concentricis, caule eramoso, foliis (2 vel) 3 imo longiore saepe spicam excedenti, laminis teretibus anguste 4-sulcatis, spica forte flexuosa 1- vel 2-flora, bracteis \pm siccis pallide translucente-brunneis 12–16 mm longis, floribus cupulatis pallide flavis in centro brunneolis, tubo perianthii infundibuliformi 7–9 mm longo, tepalis anguste ovatis 18–25 \times 6.0–8.5 mm, filamentis 12–14 mm longis per 10–12 mm exsertis, antheris ± 5 mm longis flavis, ramis styli ± 5 mm longis.

TYPE.—Western Cape, 3218 (Clanwilliam): Piketberg, lower slopes of Versfeld Pass, light stony clay in

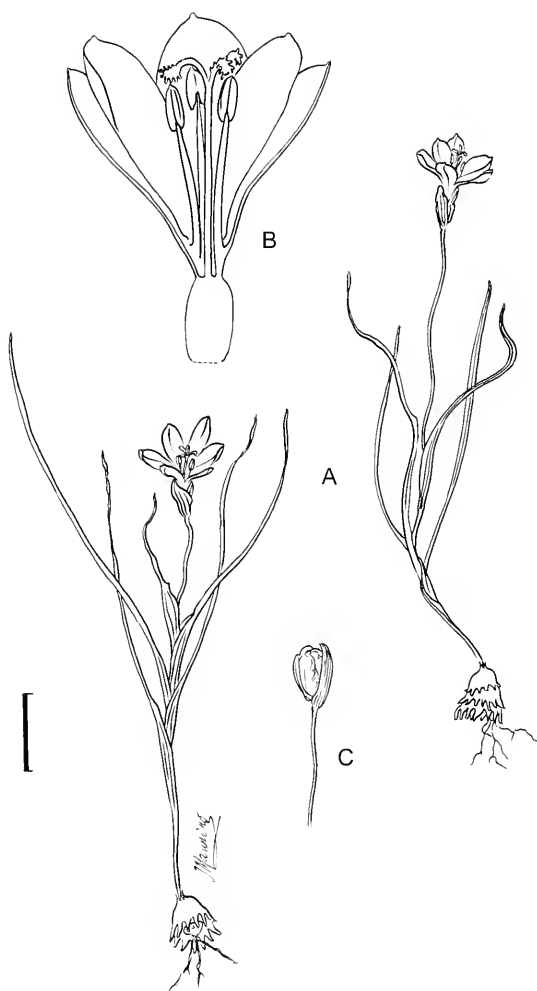


FIGURE 7.—*Geissorhiza platystigma*. Goldblatt & Porter 13202 (NBG). A, flowering plants; B, half-flower; C, capsule. Scale bar: A, C, 10 mm; B, 2.5 mm. Artist: J.C. Manning.

renosterveld, (–DC), 22 September 1992, Goldblatt & Manning 9468 (NBG, holo.; MO, PRE, iso.).

Plants 100–150 mm high, not including leaves. *Corn* globose, ± 8 mm diam., tunics light brown, concentric, splitting longitudinally and drawn into short bristles above. *Stem* simple, smooth, erect below, flexed outward above sheaths of upper two leaves. *Leaves* 3, rarely 2, lowermost longest, often exceeding spike, up to 300 mm long, uppermost inserted in middle of stem, blades terete with 4 narrow, longitudinal grooves, 0.5–1.0 mm diam. *Spike* strongly flexuose, inclined and flowers borne on upper side, (1)2- or 3-flowered; bracts \pm dry, light brown-translucent, 12–16 mm long, inner slightly shorter than outer, with two main veins and apex bilobed. *Flowers* cup-shaped, pale clear yellow, brownish in centre, drying pale yellow, unscented; perianth tube funnel-shaped, 7–9 mm long; tepals narrowly ovate, 18–25 \times 6.0–8.5 mm. *Stamens*: filaments 12–14 mm long, exserted for 10–12 mm; anthers ± 5 mm long, yellow. *Ovary* ovoid, ± 3 mm long; style dividing opposite upper third of anthers, style branches ± 5 mm long.

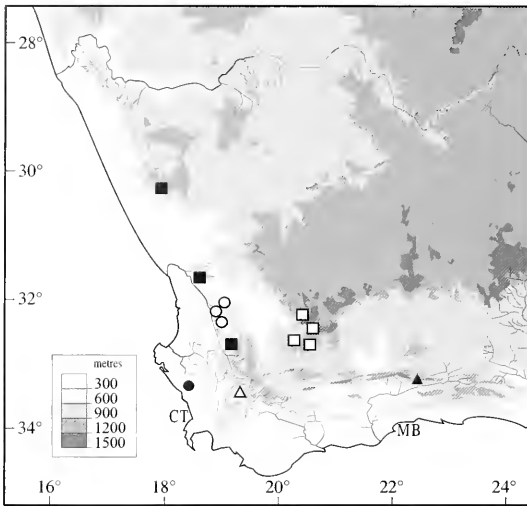


FIGURE 8.—Known distribution of *Geissorhiza cantharophila*, □; *G. demissa*, ■; *G. exilis*, △; *G. platystigma*, ●; *G. reclinata*, ▲; *G. saxicola*, ○.

Capsules and seeds unknown. Flowering time: September. Figure 9.

Eponymy: from the Latin, *sufflavus*, the pale yellow colour of the tepals.

Distribution and ecology: *Geissorhiza sufflava* is restricted to the lower eastern slopes and foot of the Piketberg range (Figure 3). Plants favour well-drained stony clay ground in renosterveld or renosterveld–fynbos transition and flower best after fire but continue to bloom for several years thereafter, until the surrounding shrubby vegetation forms a closed canopy.

Diagnosis and relationships: spikes of 1 or 2, large, pale yellow, cup-shaped flowers and the terete, four-grooved leaves, set *Geissorhiza sufflava* apart in section *Angustifolia* Goldblatt of subgenus *Weihea*. It has the typical, light brown, concentric corm tunics of the subgenus and falls closest to the widespread, small-flowered *G. juncea* (Link) D.Dietr. and the southwestern Cape endemic *G. furva* Banks ex Ker Gawl., both of which have similar, terete, four-grooved leaves. Of the two, *G. furva* has deep yellow flowers with a shorter perianth tube 3–5 mm long and tepals 15–22(–28) × 5–8(–9) mm, that spread ± at right angles to the tube when fully open, thus usually smaller and with a different orientation from those of *G. sufflava*. Even on warm days, the tepals of the often larger flowers of *G. sufflava* remain cupped rather than outspread. The two species appear to differ in ecology and distribution, and *G. furva* is endemic to the Swartland south of the Piketberg, between Hermon and Paarl, where it occurs in seasonally waterlogged clay flats. A curious feature of *G. furva* with an evident biochemical basis is that the tepals turn brownish when dry, often with a dull, metallic grey sheen, whereas those of *G. sufflava* retain their pale colour when dry.

Additional specimens examined

WESTERN CAPE.—3220 (Clanwilliam): 24 km north of Piketberg, Farm Kliprivier, (–DB), well-drained stony soil, 150 m, 6 September 2002, *Helme* 2270 (NBG); Piketberg, lower slopes of Versfeld Pass, (–DC), 23 September 1999, *Goldblatt* 11166A (MO).

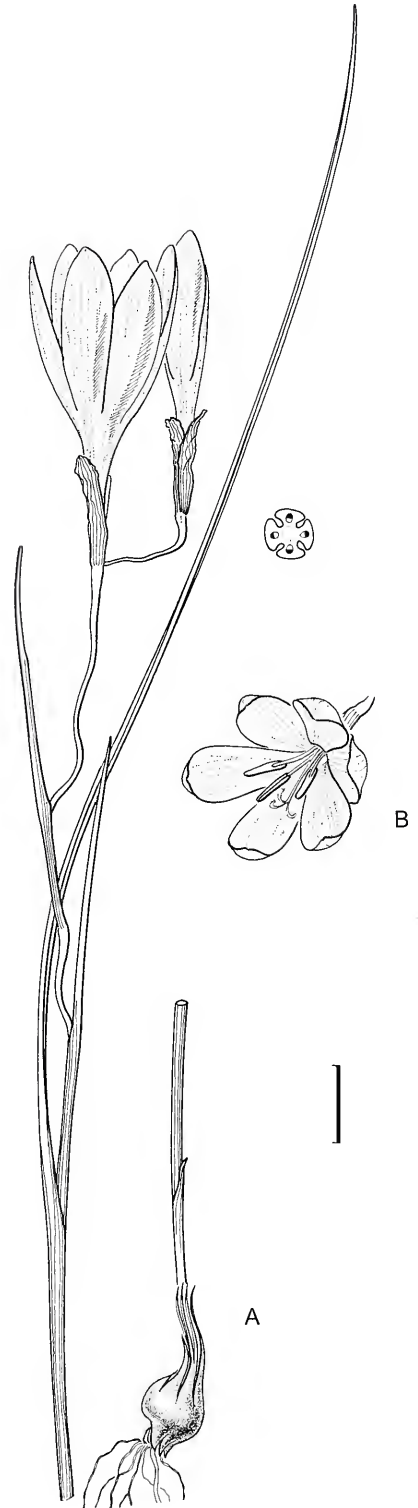


FIGURE 9.—*Geissorhiza sufflava*, Goldblatt & Manning 9468 (NBG). A, flowering plant with leaf t/s (much enlarged); B, flower. Scale bar: 10 mm. Artist: J.C. Manning.

48. *Geissorhiza helmei* Goldblatt & J.C.Manning, sp. nov.

Plantae 80–150 mm altae, cormo ovoideo 10–15 mm diam., tunicis concentricis pallide brunneis, foliis usitate 3, imo basali lamina 10–15 × 3–4 mm marginibus incrassatis alatisque extus glutinosis costa centrali incrassata marginibus alatis ciliatis, caule laevi suberecto usitate 1-ramoso, spica leviter flexuosa secunda 7- ad 10-flora ramis paucifloris, bracteis viridibus rubrovenosis marginibus membranosis 5–6 mm longis, floribus actinomorpha carneis inodoris, tubo perianthii ± 6 mm longo infundibuliformi, tepalis subaequalibus oblongis ± 12 × 5 mm, filamentis ± 6 mm longis, antheris ± 4 mm longis atropurpureis, ramis styli ± 2 mm longis.

TYPE.—Western Cape, 3218 (Clanwilliam): Piketberg, Farm Kleigat, lower slopes SE of Melkhoutkop, above track to Farm Weltevrede, burned the previous summer, 183 m, (–DA), 26 September 2006, *Helme 4200* (NBG, holo.).

Plants 80–150 mm high. *Corm* ovoid, 10–15 mm diam., tunics concentric, light brown, fragmenting vertically into segments tapering upward into short spines. *Stem* smooth, flexed outward above sheath of second leaf, suberect, usually with 1 branch, flexed at base of first flower. *Leaves* usually 3, lowermost basal, with a long, linear blade, 10–15 × 3–4 mm, margins thickened and raised into wings extended at right angles and ciliate along edges, sticky outside and with sand adhering, central vein also thickened and with winged, ciliate edges, plane and pale-coloured between margins and central vein, upper leaves similar but smaller, uppermost leaf sometimes subtending a branch. *Spike* horizontal, lightly flexuose, with flowers borne on upper side, main spike 7–10-flowered, branches with fewer flowers; bracts suberect, held ± at right angles to spike axis, green with red-flushed veins, margins membranous, outer ± 6 mm long, inner ± 1 mm shorter and forked apically. *Flowers* radially symmetric, pink, unscented; perianth tube funnel-shaped, ± 6 mm long; tepals subequal, oblong, ± 12 × 5 mm, spreading at right angles to tube. *Stamens*: filaments equal, ± 6 mm long; anthers ± 4 mm long, sagittate at base, dark purple, pollen brown. *Ovary* globose, ± 2 mm diam.; style suberect, dividing opposite middle third of anthers, style branches arched, ± 2 mm long. *Capsules* and *seeds* unknown. *Flowering time*: late August to mid September. Figure 10.

Eponymy: named in honour of N.A. Helme, a Cape Town botanist, who discovered the species.

Distribution and ecology: *Geissorhiza helmei* is a narrow endemic of the lower northern slopes of the southern arm of the Piketberg (Figure 3), growing in rocky ground in light sandy loam overlying clay. Plants were collected in the spring of 2006 after a fire earlier in the year and the species seems to be an absolute pyrophyte—a search for plants in spring in the following year failed to produce a single specimen of the species.

Diagnosis and relationships: in its general aspect *Geissorhiza helmei* recalls species of section *Engysiphon* (G.J.Lewis) Goldblatt of the genus, all members of which have fairly large corms with concentric tunics, the fragments of which taper above into short bristles,

and a single long basal leaf, always with thickened and winged margins and central vein, and with the surface of the margins glandular and with sand adhering to them (Goldblatt 1985). Most other members of this alliance have flowers with a longer perianth tube, but at least *G. brevittuba* (G.J.Lewis) Goldblatt has a short tube, ± 8 mm long, thus comparable to the tube of *G. helmei*; however, *G. brevittuba*, also restricted to the Piketberg, has larger flowers with tepals 25–30 mm long. The spike of this species typically has only 1 to 3 flowers, the stamens and style of which are unilateral and declinate, with the style dividing well beyond the anther tips.

The species is named in honour of its discoverer, the botanist N.A. Helme, who also made the first collections of two more species described here, *Geissorhiza altimontana* and *G. tricolor*, as well as the type collection of *G. demissa*, and brought them to our attention.

Subgenus *Geissorhiza*

80. *Geissorhiza demissa* Goldblatt & J.C.Manning, sp. nov.

Plantae 60–120 mm altae raro 1-ramosae, cormo ± 4 mm diam., tunicis imbricatis nigrescentibus, caule puberuloso sed subglabro infra spicam, foliis 4, duobus inferioribus basalibus linearibus vel falcatis 0.7–1.0 mm latis marginibus costaque leviter incrassatis alatis ciliatis, folio supremo caulem vaginanti, spica 1- vel 2-flora, bracteis viridibus in dimidio superiore siccis brunnescentibusque, bractea externa ± 5 mm longa interna ± 4 mm longa, floribus actinomorpha, albis pallide caeruleis infra venosis tepalis exterioribus caerulescentibus in dimidio distali, perianthii tubo ± 2 mm longo infundibuliformi, tepalis obovatis subaequalibus ± 7 × 3.5 mm, filamentis inaequalibus ± 3.5 mm longis, antheris ± 2 mm longis, stylo breviter ultra antherarum apices diviso ramis recurvatis ± 0.5 mm longis.

TYPE.—Northern Cape, 3018 (Kamiesberg): upper SE slopes of Stalberg, 3 km S of Farm Welkom, among granite boulders, 1370 m, (–AC), 28 October 2005, *Helme 3626* (NBG, holo.).

Plants delicate, 60–120 mm high, rarely with 1 short branch; stems puberulous but subglabrous below spike. *Corm* obliquely narrowly ovoid, ± 4 mm diam., with several cormlets at base, tunics woody, blackish, imbricate. *Leaves* 4, lower two basal, third leaf inserted shortly above ground, blades linear-falcate, reaching to about base of spike, 0.7–1.0 mm wide, margins and central vein lightly thickened and narrowly winged, glabrous, uppermost leaf cauline, largely to entirely sheathing. *Spike* 1- or 2-flowered; bracts green below, dry and brown in upper half to two thirds, outer ± 5 mm long, inner ± 4 mm long. *Flowers* actinomorphic, white with veins tinged blue below and reverse of outer tepals flushed blue in distal half; perianth tube funnel-shaped, ± 2 mm long; tepals subequal, obovate, ± 7 × 3.5 mm. *Stamens* unequal; filaments ± 3.5 mm long, uppermost 0.5 mm shorter, white; anthers ± 2 mm long, pollen ± white. *Ovary* with style erect, dividing shortly beyond anthers, branches recurved, ± 0.5 mm long. *Capsules* and *seeds* unknown. *Flowering time*: late August to October, probably also in early November. Figure 11.

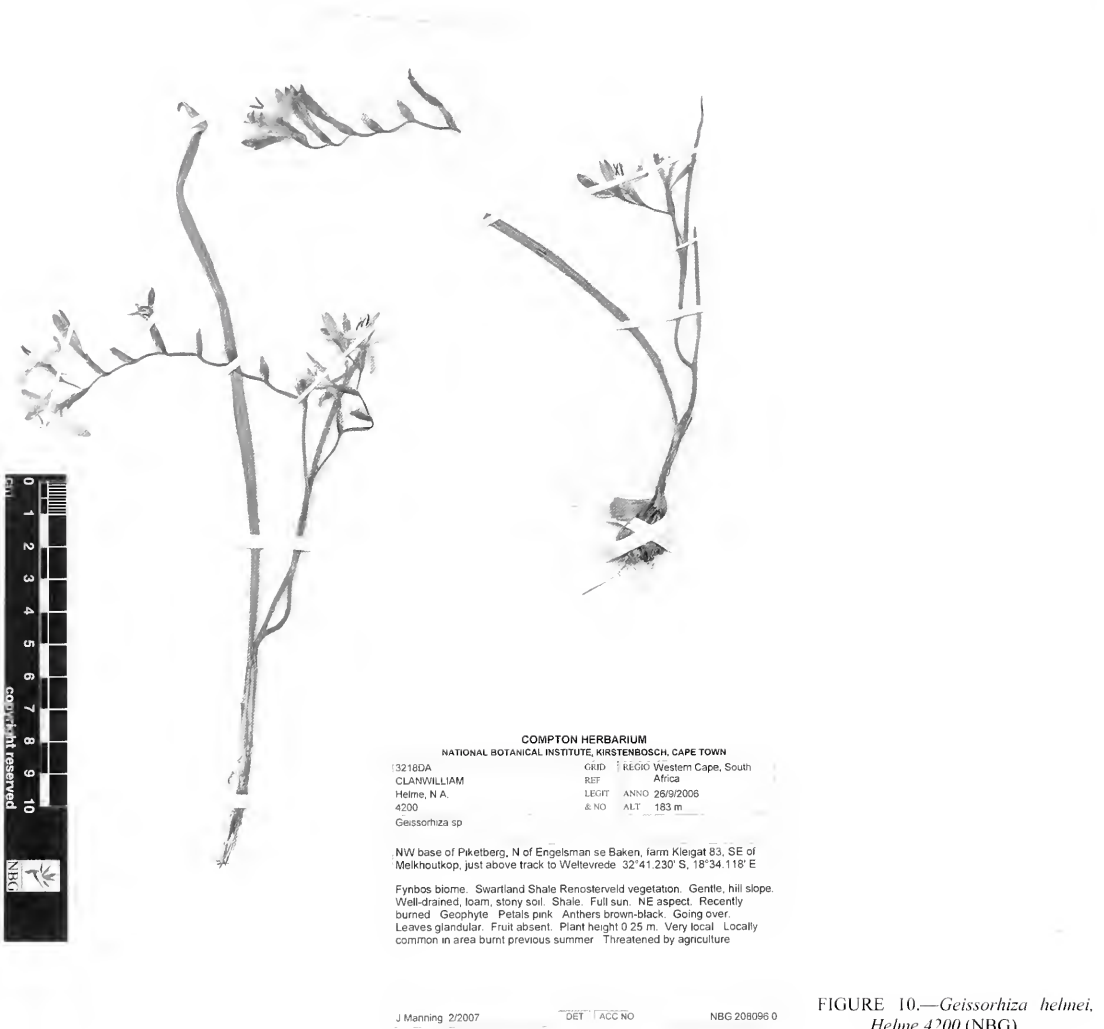


FIGURE 10.—*Geissorhiza helmei*, Helme 4200 (NBG).

Eponymy: from the Latin, *demissa*, small in stature.

Distribution and ecology: known from just three collections, one from the upper slopes of Stalberg in the Kamiesberg of central Namaqualand, and the other two from Western Cape, on the plateau of the Gifberg near Vanrhynsdorp and in the Cold Bokkeveld (Figure 8). Plants are localized and evidently uncommon in seasonally damp places in the shelter of granite boulders in the Kamiesberg or among sandstone rocks in the Western Cape mountains.

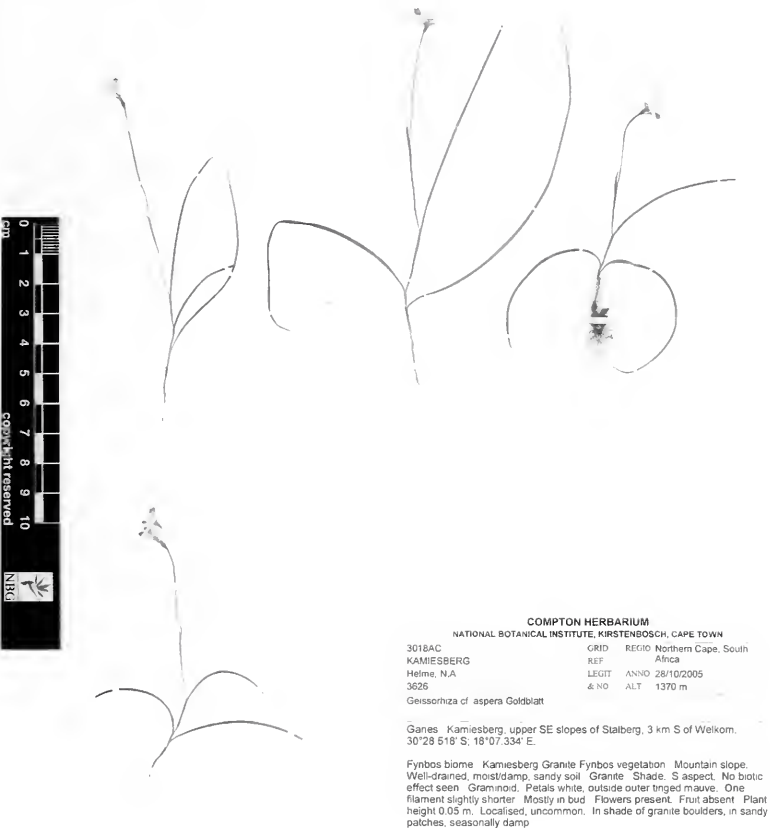
Diagnosis and relationships: imbricate corm tunics, \pm plane leaves with margins and central vein only lightly thickened, puberulous stem, and small, star-like flowers with unequal stamens, place *G. demissa* in the small section *Planifolia* Goldblatt of subgenus *Geissorhiza* (Goldblatt 1985), where it is remarkable for its small size and few-flowered spike. It is evidently closely allied to the widespread *G. aspera*, a variable species mostly with the flowers dark blue to violet although northern populations from the Cedarberg and Gifberg have white or bicoloured white and mauve flowers. *Geissorhiza aspera* is typically

larger in all respects and almost invariably branched, with leaf blades 2–7 mm wide, 2–7-flowered spikes, and stems that are puberulous up to the base of the spike, even in the northern, white-flowered populations. The unbranched stems of *G. demissa* are subglabrous below the spike and the leaves are never more than 1 mm wide. Although the flowers of the two species are similar in shape, those of *G. aspera* are larger, with tepals 11–15 \times 4–6 mm and similar short filaments, 3–5 mm long, but longer anthers, 3–5 mm vs \pm 2 mm long.

Geissorhiza aspera is common in the southwestern Cape, from Swellendam and Bredasdorp northwards to the Gifberg. It is absent from the Bokkeveld Mtns, a short distance to the north, where the morphologically similar *G. inaequalis* occurs, a more robust species with larger, purple flowers with declinate or horizontal stamens.

Additional specimens examined

WESTERN CAPE.—3118 (Vanrhynsdorp): Gifberg, plateau above pass, (–DB), 23 August 1984, *Goldblatt* 7232 (MO). 3219 (Wuppertal): Cold Bokkeveld, Wagenboomsrivier, rocky slopes just northeast of Waterval, (–CC), 10 October 2008, *Helme* 5876 (NBG).



COMPTON HERBARIUM
NATIONAL BOTANICAL INSTITUTE, KIRSTENBOSCH, CAPE TOWN
3018AC GRID REGIO Northern Cape, South
KAMIESBERG REF Africa
Helme, N.A. LEGIT ANNO 28/10/2005
3626 & NO ALT 1370 m
Geissorhiza cf. aspera Goldblatt
Ganes Kamiesberg, upper SE slopes of Stalberg, 3 km S of Welkom.
30°28'51" S, 18°07'33" E.
Fynbos biome Kamiesberg Granite Fynbos vegetation Mountain slope.
Well-drained, moist/damp, sandy soil Granite Shade, S aspect. No biotic
effect seen Graminoid. Petals white, outside outer tinged mauve. One
filament slightly shorter Mostly in bud Flowers present. Fruit absent Plant
height 0.05 m. Localised, uncommon. In shade of granite boulders, in sandy
patches, seasonally damp

Manning, J. DET ACC NO NBG 205456 0

FIGURE 11.—*Geissorhiza demissa*, Helme 3626 (NBG).

90. *Geissorhiza cantharophila* Goldblatt & J.C.Manning, sp. nov.
Plantae 250–450 mm altae, cormi tunicis imbricatis, foliis 3 duobus inferioribus laminis productis linearibus marginibus et costa incrassata alis ciliisque munitis, caule usitate 1- ad 3-ramoso, parce piloso, spica (3- ad) 5- vel 6-flora, bracteis inaequalibus bractea externa griseo-viridi ± 10 mm longa interna ± 8 mm longa membranacea atroviridi bicarinata ad apicem furcata, floribus actinomorphis, nitide carneis in centro atropurpureis, perianthii tubo 2.0–2.5 mm longo infundibuliformi, tepalis ovatis subaequalibus patentibus ± 15 × 7 mm, filamentis styloque atropurpureis, filamentis 4–5 mm longis uno ± 1 mm brevioribus quam aliis, antheris 5–8 mm longis sagittatis lobulis ad basem per ± 2 mm divergentibus, stylo ± 3 mm longo ramis adscendentibus leviter recurvatis ± 3 mm longis.
TYPE.—Western Cape, 3320 (Montagu): Klein Roggeveld, 26.5 km north of N1 on road to Sutherland from

Matjiesfontein, Farm Fortuin, (–BA), 26 August 2006, Goldblatt & Porter 12704 (NBG, holo.; MO, PRE, iso.).
Plants 250–450 mm high. *Corm* 8–10 mm diam., ovoid, tunics imbricate, blackish. *Stem* erect, sparsely short-hairy, usually 1–3-branched, bearing a scale-like bract up to 10 mm long in upper third. *Leaves* 3, lower 2 with suberect to falcate blades, upper leaf sheathing stem but free distally, blades linear, margins raised into wings held at right angles to blade, central vein raised and bearing winged edges parallel to blade surface, ciliate on marginal and central vein wings, plane between margins and central vein. *Spike* flexed outward, flexuose, (3–)5- or 6-flowered; bracts unequal, outer dull grey-green in bud with submembranous margins, drying pale straw-coloured with age, ± 10 mm long, inner ± opaque-membranous with two dark green keels, ± 2 mm shorter than outer, apically forked. *Flowers* actinomorphic, bright, glistening pink (turning blue on drying) with a glossy, dark purple central zone, filaments, style and style branches also dark purple; perianth tube fun-

nel-shaped, 2.0–2.5 mm long; tepals subequal, ovate, spreading horizontally at right angles to tube, $\pm 15 \times 7$ mm. *Stamens* unequal: filaments 4–5 mm long, one ± 1 mm shorter than other two; anthers 5–8 mm long, sagittate, thecae diverging at base for ± 2 mm, pale mauve-pink to purple, pollen pale pink (yellow when dry). *Ovary* with style slender, short, ± 3 mm long, dividing opposite lower third of filaments, style branches ascending, slightly outcurved, ± 3 mm long, extending between lower third of anthers. *Capsules* subglobose, 3-lobed, 6–7 mm long. *Seeds* tetrahedral, colliculate, ± 2 mm long. *Flowering time*: late August to mid September, occasionally lasting until early October; flowers opening late morning and closing in late afternoon. Figure 12.

Eponymy: from the Latin, *cantharis*, a beetle, and *-phila*, loving, alluding to the pollinators, scarab beetles.

Distribution and ecology: *Geissorhiza cantharophila* is restricted to Klein Roggeveld and nearby (Figure 8) and is most often found on south-trending slopes or flat ground on shale and clay. In years of ample rainfall, as in 2006, plants can be so common that in flower they colour the veld with a haze of pink for many kilometres.

Diagnosis and relationships: the blackish corm tunics with overlapping layers that split regularly along the lower margin, place *Geissorhiza cantharophila* in subgenus *Geissorhiza*. The two basal leaves have broadly winged margins and a raised and winged central vein exactly like those of its presumed immediate relatives, *G. inflexa* and *G. heterostyla*, and it also has the derived pollen grains with complex aperture and operculum characteristic of its two relatives and their immediate allies. So alike are the three species that they can be distinguished only with difficulty in the herbarium. Seen alive, however, the glistening mauve-pink to purple flowers with a dark purple centre, purple filaments and a short purple style of *G. cantharophila* are unmistakable. The style, ± 3 mm long and dividing opposite the lower third of the filaments, and the almost straight style branches are unique in the subgenus and we infer that they are associated with its pollination system. The upright flowers are adapted for pollination by hopliine beetles, two or more species of which have been found on the flowers on warm sunny days. The short style results in the placement of the style branches at exactly the right level to brush against a beetle's body as it crawls across the perianth. A longer style, such as found in its relatives, would place the style branches beyond the level of a beetle visitor. Hopliine beetles captured in the flowers include *Anisochelus inornatus*, *Anisonyx hiliaris* and *A. ignites*.

The widespread *Geissorhiza heterostyla* is vegetatively identical and is particularly difficult to distinguish from *G. cantharophila* when pressed and dried but alive, the blue to mauve or almost white flowers, pale yellow in the tube with the mouth sometimes edged in darker blue or mauve, and \pm white stamens and style branches make it easy to separate the two species. When the flowers of *G. heterostyla* first open, the spreading tepals are held at $\pm 30^\circ$ to the horizontal with the style and anthers unilateral and lying above the lowermost tepal. As the flower ages, the spike axis becomes straight and the flower is then held upright. In all but a few populations of the species, the style is relatively long and reaches the top of

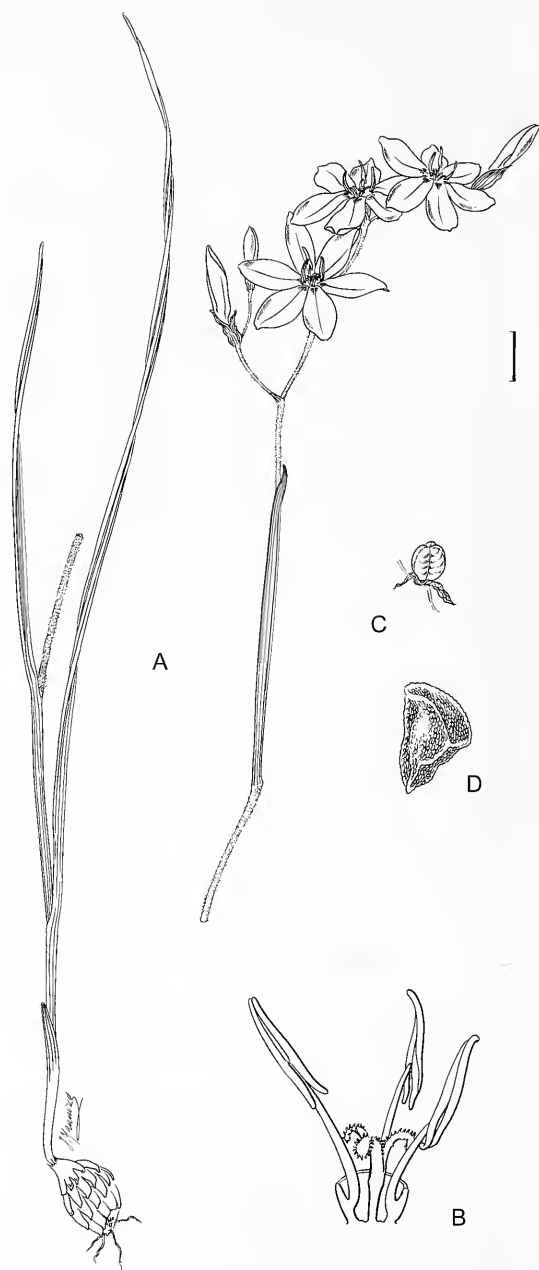


FIGURE 12.—*Geissorhiza cantharophila*, Goldblatt & Porter 12704 (NBG). A, flowering plant; B, stamens and stigma; C, capsule; D, seed. Scale bar: A, C, 10 mm; B, 3 mm; D, 1 mm. Artist: J.C. Manning.

the anthers, and the style branches are clearly recurved as in most other species of *Geissorhiza*. Locally, in the southern Roggeveld, at Whitehill and elsewhere in the northern half of its range, there are populations of *G. heterostyla* that consist of plants with long, intermediate, or short styles, a feature well illustrated in the prologue (Bolus 1930), and it is these latter plants that are most easily confused with *G. cantharophila*. Short-styled plants of *G. heterostyla* are rare in any population (about one plant in 10 had a short style in two populations we

sampled near Sutherland) and the style branches in these plants are short and recurved, thus unlike the longer, nearly straight style branches of *G. cantharophila*.

Additional specimens examined

NORTHERN CAPE.—3220 (Sutherland): Houthoek, (–CA), 10 September 1971, *Hanekom 1562* (MO, NBG, PRE); Verlate Kloof, 4300 ft [± 1410 m], (–DA), 8 September 1926, *Levy's 1647* (BOL); Klein Roggeveld, Farm Meintjieskraal, (–DC), 30 August 2007, *Goldblatt & Porter 12915* (MO, NBG, PRE); south-facing slope south of Komsberg Pass, Farm De Hoop, (–DC), 9 September 2006, *Goldblatt & Porter 12807* (MO); 13.5 miles [± 20 km] SSE of foot of Komsberg Pass, (–DC), 15 September 1955, *Acocks 18447* (BOL).

91. *Geissorhiza reclinata* Goldblatt & J.C.Manning, sp. nov.

Plantae 80–120 mm altae, cormi tunicis imbricatis atrobunneis, foliis usitate 3 duobus inferioribus prostratis linearibus marginibus costaque leviter incrassatis alatis ciliatis, folio supero caulem vaginanti sed distaliter libero, caule usitate 1- ad 3-ramoso, parce piloso, spica 1- ad 3-flora, bracteis inaequalibus bractea externa griseo-vidi ± 10 mm longa interna ± 8 mm longa membranacea viride bicarinata ad apicem integra, floribus zygomorpha, caeruleo-malvinis in centro viridi-flavis, perianthii tubo ± 2 mm longo infundibuliformi, tepalis anguste ovatis subaequalibus patentibus, 14–16 \times 7 mm, filamentis duobus 10–12 mm longis uno 8–10 mm longo, antheris 5–8 mm longis subsagittatis lobulis ad basem per ± 2 mm divergentibus, stylo reclinato ramis recurvatis ± 1.5 mm longis.

TYPE.—Western Cape, 3322 (Oudtshoorn): Swartberg, Meiringspoort, southwest-trending slopes among sandstone rocks, (–BC), 16 August 2002, *Goldblatt & Porter 12057* (NBG, holo.; MO, PRE, iso.).

Plants 80–120 mm high. *Corm* ± 8 mm diam., ovoid, tunics imbricate, dark brown, fragmenting below into tile-like sections. *Stem* erect, sparsely and short-hairy or sometimes \pm smooth in upper third, usually 1–3-branched, bearing scale-like bract up to 10 mm long in upper third. *Leaves* mostly 3, lower 2 \pm prostrate, blades linear, 80–120 \times 1.5–2.0 mm, margins and central vein raised into narrow wings held at right angles to blade, wings sparsely ciliate, upper leaf sheathing stem but free distally. *Spike* flexed outward, flexuose, 1–3-flowered; bracts unequal, green flushed purple above, margins membranous, outer ± 10 mm long, inner ± 8 mm long, apex entire. *Flowers* zygomorphic, held at $\pm 45^\circ$ from vertical, blue-mauve (turning pale lilac on drying), greenish yellow in tube, upper 3 tepals dark blue-purple at base, filaments, style and style branches pale bluish; perianth tube funnel-shaped, ± 2 mm long; tepals narrowly ovate, subequal, spreading horizontally at right angles to tube, 14–16 \times 7 mm. *Stamens* unequal; filaments 10–12 mm long, one 8–9 mm long; anthers 5–8 mm long, sagittate, thecae diverging at base for ± 2 mm, pale mauve pink, pale yellow (or brown) when dry. *Ovary* with style reclinate, lying beneath filaments, dividing opposite anther tips, style branches recurved, ± 1.5 mm long, extending above anthers. *Capsules* and *seeds* unknown. *Flowering time*: mid August to mid September, possibly later at higher elevations.

Eponymy: from the Latin, *reclinatus*, bent downward, describing the orientation of the stamens and style.

Distribution: endemic to the eastern Swartberg, *Geissorhiza reclinata* is known only from slopes above Meiringspoort east of Oudtshoorn (Figure 8). Plants grow on moist, peaty sand on southwest-trending slopes among sandstone rocks. Plants were in full bloom the year following a fire and we suspect that, as the surrounding shrubby vegetation regrows, *G. reclinata* will no longer flower.

Diagnosis and relationships: the dark brown, overlapping corm tunics and unequal filaments place *Geissorhiza reclinata* in subgenus *Geissorhiza* where it seems taxonomically isolated. It keys out in the current revision of the genus (Goldblatt 1985) with a small group of southwestern Cape mountain species, including *G. pseudinaequalis* Goldblatt and *G. scopulosa* Goldblatt, and like the latter it has sparsely short-hairy stems and leaves with the margins and central vein winged, the wing edges minutely ciliate (at least a 10 \times lens is needed to see these features). The short perianth tube ± 2 mm long is consistent with that of *G. scopulosa* but the fairly large flowers with tepals ± 15 mm long are much larger than in *G. scopulosa*, which has tepals 8–9 mm long.

96. *Geissorhiza exilis* Goldblatt & J.C.Manning, sp. nov.

Plantae 70–140 mm altae, cormo 3–4 mm diam., tunics imbricatis atrobunneis, foliis usitate 3 duobus inferioribus basalibus 30–40 \times 1.5–2.5 mm linearibus vel falcatis marginibus costaque leviter incrassatis alatis ciliatis, folio supero caulem vaginanti sed distaliter libero, caule usitate 1- vel 2-ramoso, glabro, spica 1- ad 3-flora, bracteis inaequalibus viridibus in dimidio superiore siccis brunnescentibusque, bractea externa 7–8 mm longa interna 5–6 mm longa bicarinata ad apicem furcata, floribus actinomorpha, albis tepalis exterioribus dorsalter carneis, perianthii tubo ± 1.5 mm longo infundibuliformi, tepalis ovatis subaequalibus patentibus, $\pm 8 \times 3$ –4 mm, filamentis aequalibus ± 2 mm longis, antheris 3–4 mm longis, stylo erecto ramis recurvatis ± 1.5 mm longis.

TYPE.—Western Cape, 3319 (Worcester): Waaihoek Mountains, Farm Boesmansvlei, steep slopes above vineyards, southwest-facing slopes among sandstone rocks, ± 390 m, (–CA), 22 September 2007, *Goldblatt & Manning 13014* (NBG, holo.; K, MO, PRE, iso.).

Plants 70–140 mm high. *Corm* 3–4 mm diam., ovoid, tunics imbricate, dark brown, fragmenting below into tile-like sections. *Stem* erect, smooth, usually 1- or 2-branched, bearing scale-like bract up to 10 mm long in upper third if second branch present. *Leaves* mostly 3, lower 2 erect, blades linear or falcate, 30–40 \times 1.5–2.5 mm, margins and central vein raised into narrow wings held at right angles to blade, wings prominently ciliate, upper leaf sheathing stem but free distally. *Spike* flexed outward, flexuose, 1–3-flowered, branches when present 1- or 2-flowered; bracts unequal, green becoming dry and brown in upper half, outer 7–8 mm long, inner 5–6 mm long, 2-keeled and forked apically. *Flowers* radially symmetric, upright, white with outer tepals flushed pink on reverse; perianth tube funnel-shaped, ± 1.5 mm long; tepals subequal, ovate, spreading horizontally at right angles to tube, $\pm 8 \times 3$ –4 mm. *Stamens* equal; filaments ± 2 mm long; anthers 3–4 mm long, white. *Ovary* with style erect, dividing oppo-

site upper third of anthers, style branches recurved, ± 1.5 mm long, extending above anthers. *Capsules* and *seeds* unknown. *Flowering time*: September.

Eponymy: from the Latin, *exilis*, small or slender.

Distribution and ecology: *Geissorhiza exilis* is known only from the slopes of the Waaihoek Mtns west of Worcester, where it grows on fairly steep slopes in sandy ground among sandstone boulders (Figure 8). The single collection was made in the spring following a fire during the previous summer.

Diagnosis and relationships: *Geissorhiza exilis* is identified by the narrow, sublinear to falcate leaves with the margins and central vein raised and extended into prominently ciliate wings, combined with a glabrous stem and flowers with equal filaments. Leaf morphology places the species in section *Ciliatae* (Goldblatt 1985) of subgenus *Geissorhiza* where it appears to be most like *G. inflexa*. This species is an altogether larger plant with corms 7–12 mm diam., leaves mostly at least 3–4 mm wide, and flowers with tepals at least 8 mm long and more often 10–18 mm long. The stamens of *G. inflexa* are also larger, the filaments 4–7 mm long, the anthers mostly 3–6 mm long, and the style branches 4–5 mm long. Whereas *G. inflexa* favours clay or loam slopes and flats in renosterveld, *G. exilis* is a plant of sandy slopes in fynbos habitats.

We have seen no other collections of the species but we suspect that it may not be as rare as it appears, for the plants are inconspicuous even when locally common and in full bloom. Difficulty in naming small-flowered species of *Geissorhiza* is also likely to discourage collectors.

97. *Geissorhiza saxicola* Goldblatt & J.C. Manning, sp. nov.

Plantae 35–100 mm altae, cormo ignoto, caule erecto papillato-villoso simplici vel uniramoso, foliis 3 omnibus basalibus vel folio summo cauli prope basin inserto, planis falcatis vel trahentibus sublinearibus 1.5–4.0 mm latis marginibus costaque alatis, alis prominenter pilosis, spica (1- vel) 2- ad 6-flora (ramo, si adest, 1- vel 2-floro tantum), bracteis infra viridis in dimidio superiore siccis brunneisque, bractea externa 7–8(–10) mm longa interna brevior, floribus albis usque pallide carneis, perianthii tubo infundibuliformi 1.5–2 mm longo, tepalis 7–8 \times 2–3 mm patentibus, filamentis inaequalibus duobus \pm 3 mm longis uno \pm 2 mm longo, antheris sagittatis 3.3–4.0 mm longis, stylo manifeste erecto ramis 1.3–1.8 mm longis.

TYPE.—Western Cape, 3319 (Wuppertal): Biedouw valley, east-facing slopes above Biedouw Jeugkamp, damp sheltered places among sandstone rocks, (–AA), 7 September 1992, Goldblatt & Manning 9404 (NBG, holo.; MO, iso.).

Plants 35–100 mm high. *Corm* unknown. *Stem* erect, pubescent, simple or rarely with a single short branch. *Leaves* 3, all basal or uppermost inserted on stem shortly above ground level, \pm plane, falcate to trailing, lower two longest and exceeding stem, sublinear to narrowly sword-shaped, 1.5–4.0 mm wide at widest point, margins and central veins winged with marginal wings held at right

angles to blade, wing edges prominently ciliate. *Spike* (1)2–5(6)-flowered, branch when present 1- or 2-flowered; bracts green below, dry and brown in distal half, outer bract 7–8(–10) mm long, inner slightly shorter, 2-veined to 2-keeled, usually shallowly notched at tip. *Flowers* white to pale pink, outer tepals pink to light purple outside, unscented; perianth tube funnel-shaped, 1.5–2.0 mm long; tepals 7–8 \times 2–3 mm, spreading. *Stamens* unequal; filaments with longer two \pm 3 mm long, shorter one \pm 2 mm long; anthers sagittate, 3.3–4.0 mm long. *Ovary* with style evidently erect, dividing opposite middle of anthers, style branches arching outward, 1.3–1.8 mm long. *Flowering time*: August to mid October. Figure 13.

Eponymy: from the Latin, *saxosa*, stony or rocky, and *-icola*, living in, describing the habitat.

Distribution: *Geissorhiza saxicola* is known from just three collections from the northern Cedarberg and Pakhuis Mountains east of Pakhuis Pass (Figure 8). Plants grow in sandy soil, in moist shady sites in the shelter of sandstone rocks, and may be locally abundant.

Diagnosis and relationships: *Geissorhiza saxicola* is recognized by the combination of a papillate-hairy stem, leaves with the margins and central veins winged with pilose wing edges and small, pink flowers with unequal filaments. The immediate relationships of *G. saxicola* are uncertain although it clearly falls in section *Ciliatae*. Pollen grains are specialized in their complex aperture, which places the species closest to *G. exilis* and *G. inflexa*, but in both these species the filaments are equal in length. Although its low stature and small flowers recall *G. minuta* of the Gifberg and Pakhuis Mountains, that species has a smooth stem, equal stamens, and the thickened leaf margins and central vein lack the wings with ciliate edges of *G. saxicola*. *Geissorhiza leipoldtii* is more distantly allied to *G. saxicola* but although it often has unequal stamens, the flowers are much larger (tepals (13–)18–28 mm long; anthers 6–8 mm long) and the style divides at or beyond the anther tips.

Additional specimens examined

WESTERN CAPE.—3218 (Clanwilliam) [or 3219 (–CA)]: Cedarberg, Boschklouf, shady damp places near rock, (–BB), 12 October 1923, Pocock 114 (NBG) or 3219 (–CA), 3219 (Wuppertal): Cedarberg Forest Reserve, Langrug, shady moist places on shale band, 1 000 m, (–AC), 5 September 1982, Viviers 584 (NBG).

RANGE EXTENSIONS, MORPHOLOGICAL NOTES AND TAXONOMIC CHANGES

The numbers of the species follow the classification in Table 1.

92. *Geissorhiza arenicola* L. Bolus

This blue-flowered species of subgenus *Geissorhiza* has until now been regarded as endemic to the northern end of the Bokkeveld Mountains and nearby Gifberg range, where, as its name suggests, it occurs in sandy, well-drained soils. Allied to the widespread *G. aspera*, *G. arenicola* is recognized by the puberulous stem, two basal leaves with thickened margins and raised and thickened central vein, minutely ciliate on the edges and slightly sticky on the raised surfaces, unequal fila-

ments and deep blue perianth with tepals mostly 12–15 mm long. We have now collected the species in the Olifants River Mountains west of Trawal (*Goldblatt & Porter 11888A* MO, NBG, PRE). The record establishes its range as a montane species of the northern portion of the Northwestern Centre (sensu Goldblatt & Manning 2000) of the Cape floristic region. A collection from Matjiesfontein Farm on the Bokkeveld Escarpment south of Nieuwoudtville (*Goldblatt & Nänni 11154* NBG) consists of uniformly white-flowered plants, and a white-flowered population is also known from Lokenburg, to the south. Elsewhere *G. arenicola* has blue flowers.

13. *Geissorhiza bracteata* Klatt

The recorded range for this species is the southern Cape, extending from near Swellendam eastward to Gra-

hamstown (Goldblatt 1985). New records from Burgers Pass west of Montagu extend the range some 150 km to the west (27 August 2006, *Goldblatt & Porter 12714* MO, NBG, PRE). A second collection from the Voetpadsberg near Touws River (3 October 1999, *Goldblatt & Nänni 11198* MO) in fruit is probably also this species and if correctly identified extends the range inland where it has not before been found. The Burgers Pass collection has the derived pollen type, typical of *Geissorhiza bracteata* but has prostrate leaves, unlike most other collections of the species, and the perianth tube is ± 2.5 mm long. Elsewhere in *G. bracteata*, the perianth tube is 3–5 mm long.

87. *Geissorhiza divaricata* Goldblatt

A small-flowered species, *Geissorhiza divaricata* (subgenus *Geissorhiza*) was known from the northern

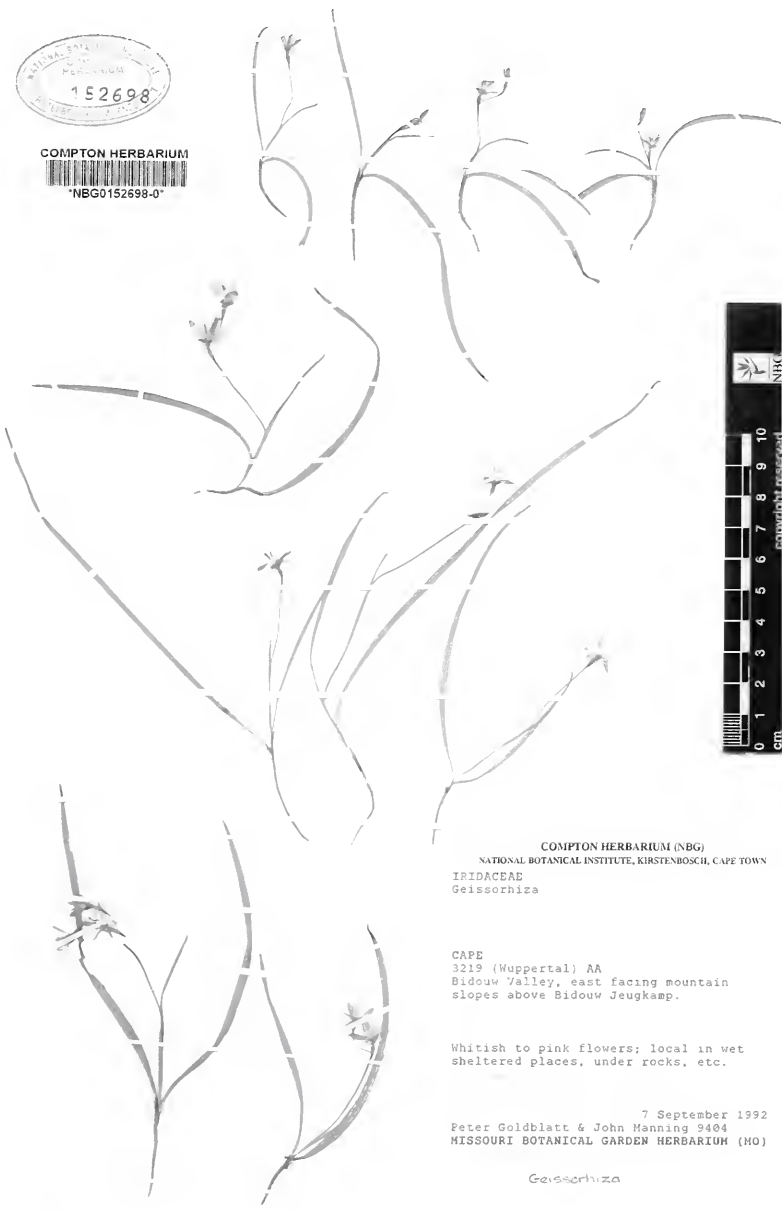


FIGURE 13.—*Geissorhiza saxicola*, Goldblatt & Manning 9404 (NBG).

Bokkeveld Mountains and the Gifberg when described (Goldblatt 1985). The slender habit, divaricate branching with the branch about as long as the main axis, tepals ± 10 mm long and the two basal leaves with raised and narrowly winged, ciliate margins and primary and secondary veins, readily distinguish the species as belonging in subgen. *Geissorhiza*. A collection made in September 2006, 40 km south of Nieuwoudtville near Moedverloor at the southern end of the Bokkeveld Mountains, is a modest range extension (Goldblatt & Porter 12432 MO, NBG). The population there consists largely of blue-flowered plants, but one pure white-flowered plant was included in the collection. Until now records of *G. divaricata* have been of plants with white flowers faintly flushed with purple and red-purple on the reverse of the tepals.

95. *Geissorhiza erosa* (Salisb.) R.C.Foster

Based on plants cultivated in England in the 1790s, this species (as *Ixia erosa*) was distinguished by the leaves with ciliate 'pleats' (what we now call marginal wings) and the tips of the tepals irregularly toothed. Nothing was mentioned about the flower colour in the protologue. The reason the name was linked to the large, red- or purple-flowered plants called *G. erosa* by Foster was his discovery of a specimen in the De Candolle Herbarium at Geneva bearing this name, which was sent by Salisbury to De Candolle (Foster 1941). This specimen is probably not a type in the current sense, but does serve to authenticate the species. Foster regarded *Ixia erosa* as the earliest valid name for the illegitimate *Geissorhiza hirta* (Thunb.) Ker Gawl. (the name used for the species by Baker, 1896, in *Flora capensis*). No types of the species described by Salisbury in his 1796 publication are known and so the matter has rested. To fix the application of the name we have designated a neotype here.

The large-flowered *Geissorhiza erosa* is vegetatively indistinguishable from *G. inflexa*, but the spikes usually have fewer flowers, usually 2–4, a perianth tube 1.5–2.0 mm long, tepals 18–24 \times 8–10 mm and anthers (6–)7–10 mm long. The outer bracts are 18–20 mm long, the inner ± 2 mm shorter. In contrast, typical *G. inflexa* also has a perianth tube ± 2 mm long, but tepals 10–15(–17) \times 5–7 mm, and anthers 4–6 mm long. The outer floral bracts are 10–15 mm long and the inner about 10–12 mm long; generally the bracts of *G. inflexa* are dry and brown at flowering, but in *G. erosa* the bracts are often green, turning light brown with age. Plants with a large, pink or occasionally white perianth that occur to the south at Villiersdorp and Bot River have, like typical *G. erosa*, tepals 18–22 mm long and anthers 8–10 mm long. Apart from perianth colour, the two sets of populations can be distinguished by bract length, tepal size and anther length (Table 3). There appear to be no consistent differences in the styles of the two species. The style generally divides opposite the level of the middle to upper third of the anthers and the style branches are 3–4 mm long.

Geographically, *Geissorhiza inflexa* in the narrow sense extends from the Piketberg and the Cape Peninsula eastward to Bredasdorp and Swellendam (Figure 14), whereas *G. erosa* occurs in the Tulbagh Valley and to the south between Villiersdorp and Bot River and near Stellenbosch, thus entirely within the range of *G. inflexa*. In view of the different pollen morphology now docu-

TABLE 3.—Comparison of taxonomically significant features of *Geissorhiza erosa* and *G. inflexa*. Filaments are measured from insertion on perianth tube to base of anther; for bracts measure the outer bracts in middle of spike

Character	<i>G. inflexa</i>	<i>G. erosa</i>
Perianth colour	white (–cream), outer tepals flushed red to purple outside	red, pink, purple, occ. white
Tepal size (mm)	10–15(–17) \times 5–7	18–24 \times 8–10
Outer bract length (mm)	11–16	18–20
Anther length (mm)	4–6	(6–)7–10
Filament length (mm)	4–5	(5–)6–7
Flowers per spike	(3)4–7	2–4(5)

mented for *G. erosa* populations, which we take as an indication that they constitute a genotype distinct from *G. inflexa*, and the associated larger and differently coloured flowers, we recommend recognition of *G. erosa* and outline its synonymy below. As noted by Goldblatt (1985), *G. inflexa* specimens from the Cape Peninsula and north of Cape Town have unusually large flowers with tepals ± 17 mm long, anthers ± 6 mm long (e.g. *Fellingham 1617* NBG; *Marsh 732* NBG), and are thus apparently intermediate between those of *G. erosa* and *G. inflexa* but their pollen grains are of the *G. inflexa* type.

***Geissorhiza erosa* (Salisb.) R.C.Foster** in Contributions from the Gray Herbarium of Harvard University 135: 52 (1941). *Ixia erosa* Salisb.: 36 (1796). Type: unknown (possible authentic material at G—Herb. DC.), neotype here designated: South Africa, [Western Cape.] Tulbagh, 9 September 1945, *Lewis 5738* (neo., NBG).

Ixia hirta Thunb.: no. 6 (1782), nom. illeg. superfl. pro *I. inflexa* D.Delaroche. *Geissorhiza hirta* (Thunb.) Ker Gawl.: 224 (1804). Type: South Africa, [Western Cape], without date, *Thunberg s.n.* (Herb. Thunberg, UPS, holotype).

Geissorhiza rosea Eckl.: 21 (1827). Type: South Africa, [Western Cape], near Tulbagh, cultivated in Cape Town, without date, *Ecklon s.n.* (S), lecto., designated by Nordenstam 1972: 282).

Hesperantha kermesina Klatt: 15: 395 (1882). *Geissorhiza erosa* var. *kermesina* (Klatt) R.C.Foster: 53 (1941). Type: South Africa, [Western Cape], between Paarl and Pont, without date, *Drège 8480* (B, effectively designated by Foster, 1941: 53, BM!, G!, K!, L, MO!, S!, iso.).

Specimens examined

WESTERN CAPE.—3318 (Cape Town): near Stellenbosch, (–DD), Aug. 1878, *Lightfoot s.n.* (BOL3194); Stellenbosch, grounds of Veterinary Research, (–DD), *Schneider sub Fellingham 1614* (NBG); Onderpappaigaiberg, lower slopes, rare on heuweltjies, (–DD), 23 August 1966, *Taylor 6882* (NBG); 3319 (Worcester): Tulbagh–Artois, (–AC), August 1885, *H. Bolus s.n.* (BOL); Tulbagh, lower slopes of Witzenberg, (–AC), 30 Sept. 1930, *Leighton 1338* (BOL, NBG); 2 miles [3 km] S of Tulbagh, (–AC), 9 September 1960, *Lewis 5740* (NBG); 1 mile [0.7 km] south of Tulbagh Road Station, (–AC), 1 September 1968, *Goldblatt 304* (BOL); Wellington, (–CC), 16 August 1926, *Lewis Grant 2376* (BOL). 3418 (Simons-town): Gordons Bay, (–AA), 26 September 1902, *H. Bolus 9939* (BOL). 3419 (Caledon): Van der Stel's Pass to Vyeboom, (–AA), 15 September 2007, *Goldblatt & Porter 12995* (MO, NBG); Farm Klipfontein, west of Queen Anne, (–AA), 20 September 2001, *Oliver & Oliver 11945* (NBG); 11 km SW of Villiersdorp, Fortuin 83, NE of Botrivier road, (–AA), 19 September 2001, *Helme s.n.* (NBG).

55. *Geissorhiza exscapa* (Thunb.) Goldblatt

The recorded range of *Geissorhiza exscapa* (Goldblatt 1985), a largely Western Cape coastal species, is from immediately north of Cape Town on the Farm Blaauw-

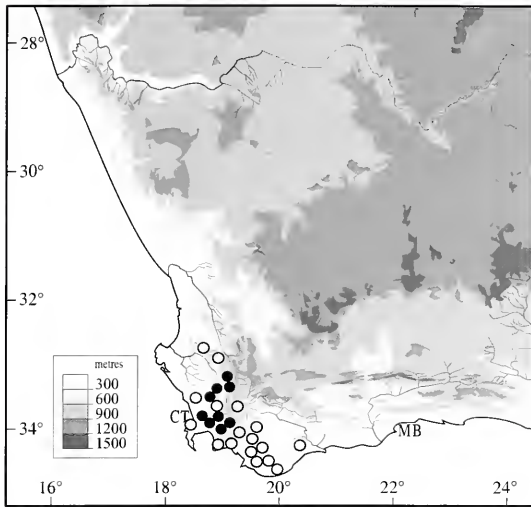


FIGURE 14.—Known distribution of *Geissorrhiza erosa*, ●; *G. inflexa*, ○.

berg in the south to near Leipoldtville in the north, inland on the Olifants River and Bokkeveld Mountains and in the sandveld inland of Hondeklipbaai in Northern Cape, the latter a disjunction of nearly 200 km. New collections from the sandveld west of Koekenaap on the Farm Kommandokraal (Goldblatt & Porter 13097 MO, NBG) and near Brand se Baai to the north (Goldblatt & Porter 13125 MO, NBG) partly fills the gap in the range, leaving some 120 km between the Brand se Baai and Hondeklipbaai populations. We suspect that *G. exscapa* occurs between these two stations but has not, as yet, been documented.

89. *Geissorrhiza heterostyla* L.Bolus

The most widespread species of the genus, *Geissorrhiza heterostyla* has been recorded from Kubiskou Mountain near Loeriesfontein in the northwest, across the Bokkeveld Escarpment and Roggeveld to the southern Cape as far east as Port Elizabeth (Goldblatt 1985). We report here a modest range extension from the Langberg, an isolated, flat-topped massif about 70 km west of Loeriesfontein at the southeastern edge of Namaqualand. Plants are restricted to the summit plateau of the range, at $\pm 1\,050$ m, where they are common among dolerite rocks in the red clay derived from decomposed dolerite (5 September 2006, Goldblatt & Porter 12770 MO; 16 September 2006, Goldblatt & Porter 12841 MO, NBG). The species occurs there in mountain renosterveld with other typical western Karoo geophytes including among the Iridaceae, *Ixia rapunculoides*, *Moraea bifida* and *M. tripetala*, and *Boophone haemanthoides* (Amaryllidaceae) (Goldblatt *et al.* 2008).

64. *Geissorrhiza minuta* Goldblatt

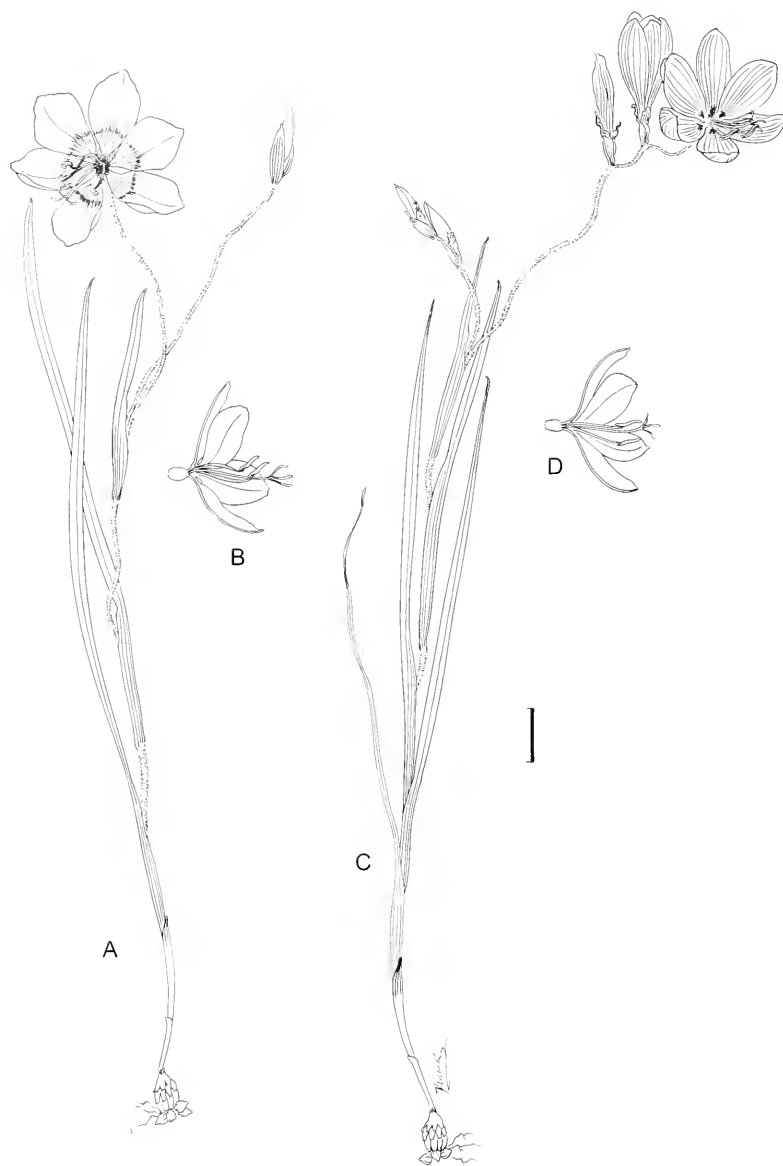
When described in 1985, this small-flowered species of section *Geissorrhiza* was known only from the immediate vicinity of Pakhuis Pass and was thought to be endemic to this limited area, north of the main Cedarberg range (Goldblatt 1985). Additional collections have now been made some 50 km to the north on the

Gifberg summit plateau (26 September 2008, Goldblatt & Porter 13189 MO, NBG) and on sandstone rocks on the Matsikamma Mtns (19 October 1998, Helme 1565 NBG). By sheer chance we were able to compare living plants in full bloom from Pakhuis Pass with those from the Gifberg in September 2008 and found them to differ in no significant way. The flowers are virtually identical in size with tepals 7–8 mm long and although white, as described, the outer tepals of both the Gifberg and Pakhuis plants are flushed light, or sometimes dark, purple outside, a feature not before recorded. We were also able to confirm that the stamens are equal in length, which was uncertain at the time the 1985 revision of the genus was published. The habitat in the northern populations is the same as at Pakhuis Pass: wet sandstone pavement in shallow sandy ground.

83. *Geissorrhiza monanthos* Eckl.

In the 1985 account of the genus, *Geissorrhiza lewisiae* R.C.Foster was included in the synonymy of *G. monanthos* (Goldblatt 1985). Field observations made since 2000 show that this decision was incorrect. Both *G. monanthos* and *G. lewisiae* have unilateral stamens and style but the flowers of *G. monanthos* have a large pale, translucent centre surrounded by a dark blue to purple or red zone, and curved, bicoloured filaments pale in the lower half but dark violet distally (Figure 15A, B). The median filament is always conspicuously shorter than the others. In contrast, *G. lewisiae* has a dark blue-violet perianth, usually pale yellow-green in the throat, uniformly violet filaments with little or no curvature, the median only very slightly shorter than the others, and the anthers are semi-prostrate (Figure 15C, D). It also usually has (1)2–5 flowers per spike in contrast to *G. monanthos*, which has 1(–4) flowers on the main spike and only one each on one or two lateral branches. Leaves of *G. monanthos* have slightly raised margins and central veins and are always glabrous, whereas leaves of *G. lewisiae* have raised and narrowly winged margins and central veins. Populations of the species from the vicinity of Saldanha have the central vein, margins and secondary veins ciliate but populations from Citrusdal and nearby have glabrous leaves. The pollen of *G. lewisiae* is pale mauve or \pm white but *G. monanthos* has red-brown or occasionally white pollen.

We now follow Foster's (1941) decision to recognize the plants with dark, blue-violet flowers with a pale, yellow-green throat as *Geissorrhiza lewisiae*. This species seems to us most closely related to *G. aspera* with which it is sometimes sympatric, but it is always distinguished by the larger flower size, unilateral, declinate stamens and style and more intense blue-violet pigmentation than *G. aspera* which has a \pm radially symmetric flower (although an eccentric style), with erect stamens. Both species have one slightly shorter filament. *Geissorrhiza lewisiae* occurs in two disjunct sets of populations: a northern one around Citrusdal in the Olifants River Valley, and a western set along the Western Cape coast, from Steenberg Cove on St Helena Bay to Saldanha Bay (Figure 16). Although typically associated with granite outcrops, it also occurs on limestone pavement and calcrete in the vicinity of Saldanha Bay. *Geissorrhiza monanthos* occurs further south, extending from Darling and Mamre (Groenekloof) inland to Malmesbury and

FIGURE 15.—*Geissorhiza monanthos*.

A, flowering plant; B, half-flower, *Geissorhiza lewisiae*. C, flowering plant; D, half-flower. Scale bar: 10 mm. Artist: J.C. Manning.

south to Klipheuwel and Joostenberg (Figure 16), typically occurring on gravelly, granite-derived soils.

***Geissorhiza monanthos* Eckl.**, Topographisches Verzeichniss der Pflanzensammlung von C.F Ecklon: 21 (1827); R.C.Foster: 39 (1941), as *G. monantha* (Thunb.) Eckl.; Goldblatt: 422 (1985, including *G. lewisiae*). *Ixia monanthos* Thunb.: 226 (1811), hom. illeg. non D.Delaroche (1766) (= *Sparaxis* sp.). Type: South Africa, Cape: exact locality unknown, Thunberg s.n. (Herb. Thunb. 975 UPS!), lecto., designated by Goldblatt 1982).

Plants 100–160(–250) mm high. *Corm* narrowly ovoid, ± 3.5 mm diam., bearing a cluster of cormlets at base, tunics imbricate, black. *Stem* minutely puberulous, simple or 1-, sometimes 2- or 3-branched. *Leaves* 3 or 4, lower $2 \pm$ basal, \pm linear to narrowly sword-shaped, slightly shorter than stem, blade narrowed and subpetiolate below, 1.5–4 mm wide, \pm plane with central vein

and margins slightly thickened, glabrous, uppermost leaf inserted in upper third of stem, much shorter than basal leaves. *Spike* nodding, 1 or 2(–5)-flowered, branches 1-(or 2)-flowered; bracts green below, becoming dry and brown in upper half, outer 10–13 mm long, inner 7–10 mm long. *Flowers* second, zygomorphic, violet with glossy translucent white centre broadly edged with a band of intense violet or red; perianth tube ± 2 mm long; tepals subequal, obovate, 14–18 \times 9–12 mm, sometimes narrowed into claws below leaving tepals windowed near bases. *Stamens* unilateral, declinate, unequal; filaments with lower two (6–)8–10 mm long, uppermost ± 1.5 mm shorter, slightly thicker in middle, curving upward distally, white below, distal two-thirds violet; anthers 5–6 mm long, ascending, violet, pollen white or brown. *Ovary* with style dividing opposite anther tips, branches recurved, 3–4 mm long. *Flowering time*: late August to end of September. Figure 15A, B.

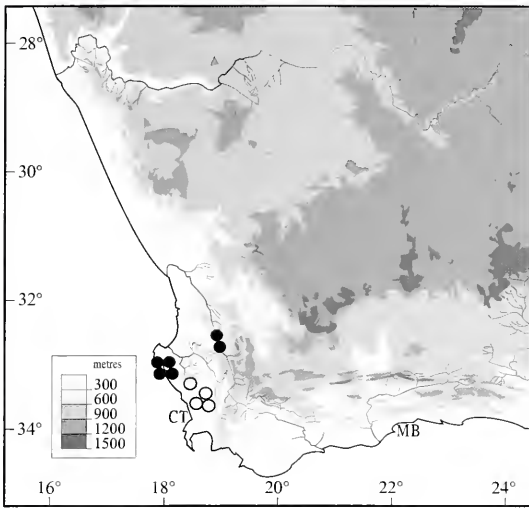


FIGURE 16.—Known distribution of *Geissorhiza lewisiae*, ●; *G. monanthos*, ○.

Selected specimens

WESTERN CAPE.—3318 (Cape Town); near Darling, (–AD), 13 September 1931, *Salter 1350* (BM, BOL), *Lavis s.n.* (BOL19877), 7 September 1953, *Barker 8045* (NBG); hills around Darling, (AD), *H. Bolus 12844* (BR, MO, PRE); Groenekloof [Mamre], (–AD), 1898, *MacOwan s.n.* in *Herb. Norm. Austr. Afr.* 810 (B, BM, BOL, G, K, S, SAM), *H. Bolus 4341* (BOL, K); granite outcropping, Mud River road, (–AD), *Goldblatt 6286* (K, MO, PRE); near Oudepost, Malmesbury to Hopefield, (–BA), 28 September 1933, *Salter 3873* (BM, BOL, K); Abbottsdale Station, (–BC), 24 September 1949, *Martin 1168* (NBG); 10 km south of Malmesbury, hills west of Nassau, Farm Morgenwagt, (–DA), 17 September 2002, *Helme 2560* (NBG); 5.3 miles (± 7.5 km) north of Klipheuwel station, (–DA), 16 September 1982, *Acocks 20644* (NBG, PRE); N of Klipheuwel, (–DA), 16 September 1982, *Van Zyl 3186* (NBG); 0.3 mi. NE of Klipheuwel, (–DA), 6 October 1955, *Lewis 4450* (SAM); Hercules Pillar, (–DD), 20 September 1944, *Leighton 556* (BOL, K); Klapmuts, hard sandy ground, (–DD), 6 October 1955, *Lewis 4449* (MO, PRE, SAM); Joostenberg, sandy flats, (–DD), 18 October 1961, *Lewis 5902* (NBG); Bottellaryberg, Farm Koopmans-kloof, (–DD), 13 September 1988, *Beyers 77* (NBG).

82. *Geissorhiza lewisiae* R.C.Foster in Contributions of the Gray Herbarium of Harvard University 135: 45 (1941). TYPE: South Africa, Cape: Langebaan, 7 September 1932, *Lewis s.n.* (K, holo., not seen; BOL20303, iso!).

Plants 150–300 mm high. *Corm* narrowly ovoid, ± 4 mm diam., with several cormlets at base. *Stem* puberulous, often 1-, sometimes 2-branched. *Leaves* usually 4, lower two basal, blades ± linear, mostly 2–4 mm wide, margins and central vein somewhat thickened and narrowly winged, glabrous or wing margins and secondary veins ciliate-hairy, uppermost cauline leaf sparsely hairy to smooth. *Spike* nodding in bud, flexuose, (1)2–5-flowered, branches with fewer flowers; bracts green below, dry and brown in upper half to two-thirds, outer 10–17 mm long, inner 8–12 mm long. *Flowers* secund, zygomorphic, glossy dark violet, yellow-green at base of tepals and in throat narrowly edged darker violet; perianth tube funnel-shaped, ± 2 mm long; tepals subequal, oblanceolate, outer 15–18 × 7–8 mm, inner longer and narrower, 17–20 × ± 5 mm. *Stamens* unilateral, declinate, unequal; filaments 6–8 mm long, uppermost 0.5–1.5 mm shorter, laxly reclinate, violet, sometimes pale yellow-green at base; anthers 5–6 mm long, reclinate,

pale violet, pollen white or mauve. *Ovary* with style reclinate, dividing opposite anther tips, branches recurved, 3–4 mm long. *Flowering time*: late August to end of September. Figure 15C, D.

Selected specimens

WESTERN CAPE.—3217 (Vredenburg); Steenberg Cove, (–CC), 2 September 1944, *Leighton 601* (BOL, K, PRE), *Lewis 1038* (BOL, PRE, SAM); Jacobsbaai, calcrete, (–DD), 29 August 2005, *Helme 3536* (NBG); Witteklip, near Vredenburg, (–DD), 1 September 1944, *Leighton 597* (BOL), *Lewis 1039* (SAM), *Compton 15915* (NBG); 18 September 1980, *Goldblatt 5846* (MO, NBG, US). 3218 (Clanwilliam); 5 miles [± 7 km] north of Citrusdal, (–CA), 1 September 1948, *Compton 20761* (NBG); 26 August 1957, *Lewis 5201* (NBG). 3317 (Saldanha); Postberg, (–BB), 8 September 1957, *Lewis 5244* (NBG). 3318 (Cape Town): Olifants Kop, east of Langebaan, (–AA), September 1974, *Goldblatt 2705* (BR, MO, PRE, S, US, WAG).

54. *Geissorhiza tenella* Goldblatt

Geissorhiza tenella, one of three species of *Geissorhiza* (all subgenus *Weilhea* section *Engysiphon*) with leaves H-shaped in section with broadly winged margins held ± at right angles to the blade surface, is a lowland species of sandy, coastal and near inland habitats. Its recorded range is from Yzerfontein northwest of Darling in the west to De Hoop, near Bredasdorp in the south-east. A collection from Skulpiesbaai Reserve, Stilbaai (13 October 2000, *De Villiers & Pienaar SKB20* NBG) extends the range some 60 km to the east. Plants of this collection have a perianth tube 25–30 mm long and tepals 13 × 2 mm, the shortest and narrowest recorded in the species. Flower dimensions recorded until now for the species are perianth tube (20–)30–40(–50) mm long and tepals 14–23 × 3.0–4.5 mm (Goldblatt 1985).

FLORAL ECOLOGY

Vogel (1954), in his touchstone account of pollination in the southern African flora, predicted (largely based on floral morphology) that *Geissorhiza* was primarily a bee-pollinated genus. He also inferred that at least *G. juncea* (thought by him to have flowers open at night) was moth-pollinated and that *G. fourcadei*, *G. ovata*, and *G. namaquensis* were adapted for the syndrome he called phalaenophily, in which he included butterflies and long-proboscid flies. Vogel made no direct pollinator observations in *Geissorhiza* but knew of Scott Elliot's (1891) report of visits to *G. aspera* (as *G. secunda*) by bees (two species of Halictidae and *Apis mellifera*) and a bee fly (Bombyliidae). Pollination in *Geissorhiza* has remained among the least known of any African genus of Iridaceae (Goldblatt & Manning 2006) and we thus present those observations that we have accumulated over the past 15 years, noting that a more thorough study of floral ecology of *Geissorhiza* is needed.

A study of pollination at one site, Lions Head, Cape Town (Nänni unpubl. data, 1994 and 1995), has shown that four sympatric and ± co-blooming, short-tubed and small-flowered species, *G. aspera*, *G. inflexa*, *G. juncea* and *G. pusilla* are pollinated predominantly by small bees (mainly Halictidae) but with occasional visits by bee flies (Bombyliidae). Hover flies (Syrphidae) and hopline beetles were also captured while visiting *G. aspera* and *G. pusilla*, and in addition, *Braunsapis* spp. (Apidae) and honey bees were captured on *G. aspera*

flowers (Table 4). For *G. inflexa* and *G. juncea*, halictid bees far outnumbered visits by other insects. The long-tubed *G. ovata*, also present at the Lions Head site and co-blooming, was occasionally visited by halictids but its long tube and ample nectar suggests that these insects are not its legitimate pollinators as they cannot reach the nectar held within the lower part of the tube. The white and pink flower of *G. ovata* combined with the well-developed tube suggest tabanid flies are the legitimate pollinators but none were seen at the Lions Head site, nor at a second site at Sir Lowry's Pass where we observed open flowers for two consecutive mornings on warm days ideal for pollinator studies.

Experimental pollinations conducted at Lions Head using standard methods for establishing self and cross compatibility showed that *Geissorhiza aspera* and *G. pusilla* are self-compatible when pollinated by hand but showed reduced seed-set when not manipulated by hand (in both crosses insect visitors were excluded). In contrast, *G. inflexa*, *G. juncea* and *G. ovata* were self-incompatible. Attempts to produce interspecific hybrids by hand-crossing consistently failed, whether species from the same or different subgenera are crossed. These results complement a report of self-compatibility and autogamy in *G. corrugata* (Goldblatt 1985) and our determination here of self-compatibility in *G. heterostyla*, otherwise unknown in the genus. In one respect these results are surprising, for interspecific crosses are readily made in *Gladiolus*, *Sparaxis* and *Watsonia*, all members of the same subfamily, Crocoideae (Horn 1962; Goldblatt & Manning 1998). Production of interspecific crosses is, however, possible in *Geissorhiza*, for there are occasional records of naturally occurring hybrids in the genus. One of these is a report of interspecific hybrids between *G. aspera*, *G. inflexa* and *G. tulbaghensis* (Loubser 2185, 2188 BOL, NBG); another between *G. ovata* and *G. parva* (Goldblatt 1985) and a third between *G. brehmii* and *G. radians* at Koelenhof near Stellenbosch (Beyers 80 NBG). The hybrids exhibit various degrees of intermediacy between the species involved.

Observations that we have accumulated since 1998 while studying the pollination of other genera of Iridaceae add modestly to this record (Table 4). Species with a short perianth tube (typically 2–4 mm long) and a radially symmetric flower, including *G. imbricata*, *G. juncea*, *G. karooica*, *G. louisabolusiae* and *G. ornithogalooides*, are pollinated by female bees of the families Andrenidae, Colletidae and Halictidae and worker honey bees (Table 4), sometimes in combination with hopliine beetles or short-proboscid Tabanidae or butterflies. The only pollinator we have seen and captured on pink-flowered *G. foliosa*, which has a perianth tube \pm 5 mm long, was the butterfly, *Colias electo*. Putative pollinators captured on *G. heterostyla* at different sites included halictid bees (*Patellapis* spp.), as well as the hopliine beetles, *Anisonyx* and *Anisochelus*, and at one site *Colias electo* alone. Nectar volumes were always small, 0.5 μ l or less, sampled in the field using unbagged flowers. Nectar is evidently lacking in *G. bracteata*, *G. foliosa*, *G. louisabolusiae* and *G. tulbaghensis* (flowers we examined had no nectar in the middle of the afternoon). In contrast, we recorded nectar of high concentration in one population of *G. karooica* (46.5–> 50 %) and uniformly > 50 % in

a second population of *G. karooica* as well as in *G. heterostyla* and *G. ornithogalooides*.

Populations of *Geissorhiza inflexa* with small white flowers seem primarily bee-pollinated; we have captured only *Apis mellifera* on flowers of the species at one site, and halictid bees, pierid butterflies and bombylid flies at another. The large red flowers of the Tulbagh form of *G. erosa* were visited by pollen-collecting female *Melitta* sp. (Melitidae) and *Scapter heterodoxus* (Colletidae) bees and by two species of hopliine beetles (Table 4). These red-flowered populations thus appear to have a bimodal pollination strategy (sensu Manning & Goldblatt 2005), offering pollen to bees and a large, brilliantly coloured perianth to attract hopliines to a suitable site for assembly and copulation.

Particularly notable is our observation for *Geissorhiza inconspicua* and *G. ramosa* (Table 4), which were actively pollinated by empidid flies (*Empis* cf. *mavittii*: Empididae), small nectar-feeding Diptera \pm 5.5 mm long, in combination with small halictid bees (*Lasioglossum* spp.). Both these species of *Geissorhiza* had small white flowers at our study site in Tradouw Pass (and both may also have blue flowers). We have been unable to repeat observations on additional populations of either species. We know of no other published records of pollination in the family by empidid flies but we confirmed that the flies brushed against stigmatic surfaces and carried dorsal loads of pollen, exclusively of *G. foliosa* and *G. ramosa*, on their bodies. Thus at least at the Tradouw Pass site, empidid flies were effective agents for pollen transfer, as were the halictid bees, which were far outnumbered by the empidids. Empidid flies have also been recorded by us on the short-tubed flowers of *Ixia rapunculoides*, *Sparaxis pillansii* and *S. tricolor* at sites on the Bokkeveld plateau (unpublished observations). The two *Sparaxis* species are believed to be adapted for hopliine pollination (Goldblatt *et al.* 2000b) and *I. rapunculoides* for large anthophorine bee pollination (Goldblatt *et al.* 2000a).

Observations of pollination in the strikingly coloured, dark blue, red and white flowers of the *Geissorhiza radians* group are still unfortunately limited. We captured unidentified halictid bees and the horsefly *Philoliche atricornis* on *G. eury stigma* and the bee *Andrena* sp. (Andrenidae) and beetle *Anisonyx ursus* (Scarabaeidae–Hopliini) on *G. monanthos*. Again, these insects carried loads of pollen of the host species and were seen to brush against stigmatic surfaces. *Geissorhiza splendissima*, which has a brilliant blue perianth and brown anthers and pollen, is visited by *Apis mellifera* and the large *Anthophora longipes*.

Geissorhiza cantharophila is so far the only species of the genus shown to be primarily adapted for pollination by hopliine beetles. As mentioned above, we captured three species of beetles on flowers of the species at two different sites, *Anisonyx hilaris*, *A. ignitus* and *Anisochelus inornatus* (Table 4). We infer the same pollination system for *G. tricolor* because of its flower pigmentation: bright yellow with a large dark-brown central eye. The purple-flowered form of *G. aspera* from Malmesbury also requires mention here. Unlike the blue-violet- and white-flowered populations, which have a yellow-green tube edged in a darker colour, in the Malmesbury

TABLE 4.—Insect pollinators captured on *Geissorhiza* species with plant voucher number. Arranged by subgenus (bee vouchers are deposited at the Snow Entomological Museum, Lawrence, Kansas; long-proboscid flies at KwaZulu-Natal Museum, Pietermaritzburg). Abbreviations: *G.*, Goldblatt; *M.*, Manning; *N.*, Nänni; *P.*, Porter

Taxon	Captured insects (plant voucher data or reference if not an original report)
Subgenus <i>Weihea</i>	
Section <i>Engysiphon</i>	
<i>G. bonaspei</i> Goldblatt	<i>Prosoeca nitidula</i> , <i>Philoliche rostrata</i> (<i>G</i> 11640 MO)
<i>G. confusa</i> Goldblatt	<i>Philoliche gulosa</i> (<i>G</i> & <i>N</i> 10572 MO); <i>P. rostrata</i> (<i>G</i> & <i>M</i> 10119, 11042 MO)
<i>G. exscapa</i> (Thunb.) Goldblatt	<i>Moegistorhynchus longirostris</i> (<i>G</i> & <i>M</i> 10346, <i>G</i> & <i>P</i> 12628 MO); (Manning & Goldblatt 1997)
<i>G. schinzii</i> (Baker) Goldblatt	<i>Prosoeca westermanni</i> (not captured) (<i>G</i> & <i>M</i> 11035 MO)
<i>G. tenella</i> Goldblatt	<i>Moegistorhynchus longirostris</i> (Manning & Goldblatt 1997)
Sections <i>Weihea</i> and <i>Angustifolia</i>	
<i>G. bracteata</i> Klatt	<i>Apis mellifera</i> (<i>G</i> & <i>P</i> 12714 MO)
<i>G. foliosa</i> Klatt	<i>Colias electo</i> (<i>G</i> & <i>M</i> 10783 MO)
<i>G. hispidula</i> (R.C.Foster) Goldblatt	halictid bee (<i>G</i> & <i>N</i> 11934 MO)
<i>G. inconspicua</i> Baker	<i>Empis</i> cf. <i>maviti</i> , <i>Lasioglossum</i> spp. (<i>G</i> & <i>N</i> 11580 MO, NBG)
<i>G. juncea</i> (Link) A.Dietr.	<i>Patellapis</i> sp. (<i>G</i> 11554, MO); Halictidae (4 spp.), <i>Scapter</i> sp. (no voucher)
<i>G. karooica</i> Goldblatt	<i>Apis mellifera</i> (<i>G</i> & <i>P</i> 12929 MO, NBG)
<i>G. ornithogaloidea</i> Klatt	<i>Apis mellifera</i> , <i>Vanessa cardui</i> (<i>G</i> & <i>N</i> 11197 MO)
<i>G. purpurascens</i> Goldblatt	<i>Hoplitis</i> sp., <i>Anisonyx ursus</i> (<i>G</i> & <i>M</i> 11560 MO)
<i>G. pusilla</i> (Andr.) Klatt	Halictidae (3 spp.), Bombyliidae, Syrphidae (no voucher)
Subgenus <i>Geissorhiza</i>	
<i>G. aspera</i> Goldblatt	<i>Apis mellifera</i> (<i>G</i> & <i>M</i> 9403 NBG); Halictidae (2 spp.) <i>Braunsapis</i> sp., <i>Apis mellifera</i> , <i>Anisonyx ursus</i> , Bombyliidae, Syrphidae (no voucher); <i>Apis mellifera</i> , <i>Anthophora diversipes</i> (white form, <i>G</i> & <i>P</i> 13072 MO, NBG); <i>Anisonyx ursus</i> (purple form, <i>G</i> & <i>P</i> 13160 MO)
<i>G. cantharophila</i> Goldblatt & J.C.Manning	<i>Anisochelus inornatus</i> (<i>G</i> & <i>P</i> 12704 MO, NBG); <i>Anisonyx hilaris</i> , <i>A. ignitus</i> , (<i>G</i> & <i>P</i> 12915 MO)
<i>G. eurystigma</i> L.Bolus	halictid bee (109), <i>Philoliche atricornis</i> (no voucher)
<i>G. heterostyla</i> L.Bolus	<i>Patellapis</i> sp., <i>Apis mellifera</i> , <i>Anisonyx ignitus</i> , <i>Anisochelus inornatus</i> (<i>G</i> & <i>P</i> 12791 MO, NBG); halictid bees (not captured), <i>Anisochelus inornatus</i> (<i>G</i> & <i>P</i> 12792 MO); <i>Colias electo</i> (<i>G</i> 11431 MO); <i>Lasioglossum</i> sp., <i>Anisochelus inornatus</i> (<i>G</i> & <i>P</i> 12801 MO); <i>Lasioglossum</i> sp., <i>Apis mellifera</i> (<i>G</i> & <i>P</i> 12962 MO)
<i>G. imbricata</i> (D.Delaroche) Ker Gawl.	halictid bee (<i>G</i> & <i>N</i> 11937 MO)
<i>G. inflexa</i> (D.Delaroche) Ker Gawl. (small white flowers) (large scarlet flowers)	<i>Apis mellifera</i> (<i>G</i> 10310A MO); Halictidae (1 sp.), Bombyliidae, Pieridae (no voucher) <i>Scapter heterodoxus</i> , <i>Melitta</i> sp., <i>Peritrichia rufotibialis</i> , <i>Lepithrix ornatella</i> (<i>G</i> 11426 MO)
<i>G. louisabohlsiae</i> R.C.Foster	<i>Lasioglossum</i> (2 spp.), <i>Patellapis</i> sp. (<i>G</i> & <i>P</i> 12605 MO, NBG)
<i>G. monanthos</i> Eckl.	<i>Andrena</i> sp., <i>Anisonyx ursus</i> (<i>G</i> & <i>N</i> 11553 MO)
<i>G. ramosa</i> Ker Gawl. ex Klatt	<i>Empis</i> cf. <i>maviti</i> , <i>Lasioglossum</i> spp., <i>Apis mellifera</i> (<i>G</i> & <i>N</i> 11578 MO, NBG)
<i>G. splendissima</i> Diels	<i>Apis mellifera</i> , <i>Anthophora longipes</i> (<i>G</i> & <i>P</i> 13194 MO)
<i>G. tulbaghensis</i> F.Bolus	<i>Philoliche atricornis</i> (<i>G</i> & <i>M</i> 13019; <i>G</i> 11573 MO)

populations the flowers are purple with the filaments and throat dark purple-black. We suspect the population has shifted from a generalist to an exclusively hopliine pollination system. *Anisonyx ursus* is sometimes seen on the flowers. Apart from perianth and filament pigmentation, we find no differences with typical *G. aspera*. This unusual form is threatened today by urban development as new suburbs develop around Malmesbury.

Lastly, the southwestern Cape endemic, *Geissorhiza tulbaghensis*, which has large, zygomorphic, white flowers with a dark brown centre, is visited exclusively by the horsefly, *Philoliche atricornis*, also a common visitor to co-blooming *Arctotheca capensis* and *Dimorphotheca pluvialis* (Asteraceae). These two species have flower heads with dark disk florets and yellow or white rays. We speculate that *G. tulbaghensis* is a Batesian mimic of these species of Asteraceae as it offers no apparent reward to the flies; the flowers lack nectar and the pollen is held distant from the dark centre of the flower, so that only the dorsum brushes against them. Captured flies all carried dorsal loads of brown *G. tulbaghensis* pollen and ventral loads of yellow asteraceous pollen. These naked-eye pollen identifications were confirmed by microscopic examination.

The remaining information about floral ecology of *Geissorhiza* consists of observations on pollinator and nectar characteristics accumulated during studies of the nemestrinid fly *Moegistorhynchus longirostris* (Nemestrinidae) pollination guild (Manning & Goldblatt 1997) and of long-proboscid fly pollination systems in southern Africa (Johnson & Steiner 1997; Goldblatt & Manning 2000b). Species of section *Engysiphon* (subgenus *Weihea*) with narrow, elongate perianth tubes exceeding 20 mm, are pollinated exclusively by long-proboscid flies: *G. bonaspei* by *Prosoeca nitidula* and *Philoliche rostrata* (Tabanidae); *G. exscapa* and *G. tenella* by *Moegistorhynchus longirostris* and *G. confusa* by *Philoliche rostrata*. We confirm pollination by long-proboscid flies in *G. confusa* and *G. exscapa* here with a record of *Philoliche gulosa* pollinating flowers of the former in Van der Stel's Pass near Bot River, and *M. longirostris* pollinating the latter in the Olifants River Mtns near Graafwater. We have also observed *G. schinzii* of section *Engysiphon* being visited by *Prosoeca westermanni* in the Houw Hoek Mountains, but the flies avoided capture (Table 4). In addition, *G. kamiesmontana* of section *Ciliata* (subgenus *Geissorhiza*), which has a perianth tube

18–25 mm long, and *G. stenosphon* with a tube 40–50 mm long, are inferred to be pollinated by long-proboscid flies. The violet flower colour in *G. kamiesmontana* suggests it belongs to the *Prosoeca peringueyi* pollination guild (Manning & Goldblatt 1996) and the white flower of *G. stenosphon* suggests pollination by *M. longirostris* or *Philoliche rostrata*. Nectar of these long-proboscid fly-pollinated species is of moderate volume (1.9–5.6 µl) and concentration (19.6–29.0 % mean sucrose equivalents) (references cited above and unpublished for *G. schinzii*).

Available information thus shows two primary patterns in *Geissorhiza*. The majority of species with radially symmetric flowers and a short perianth tube have a mixed (or generalist) pollination system using a range of female bees of at least four families and worker honey bees, sometimes together with hopliine beetles, and occasionally butterflies, short-proboscid tabanid flies, bee flies and hover flies. Small halictid bees are the most frequent visitors. Visits by *Apis mellifera* workers may be opportunistic for we have seen no other large-bodied bees of the family Apidae visiting *Geissorhiza* flowers. A second pattern is the specialization for long-proboscid fly pollination in species with narrow, elongate tubes and unilateral stamens. Pollination primarily or exclusively by hopliine beetles is known for just one species, *G. cantharophila*, but is likely in a few more, e.g. *G. tricolor* described above. *Geissorhiza tulbaghensis* appears to be a radiate daisy flower mimic. Deceptive pollination using short-proboscid Tabanidae is unique not only in the genus but in Iridaceae and we know of no other examples matching the pollination system we found in *G. tulbaghensis*. Deceptive pollination using long-proboscid flies has been inferred for two species of *Hesperantha* (Iridaceae) and one of *Pelargonium* (Geraniaceae) (Goldblatt *et al.* 1995, 2004a) but these species have flowers that mimic those of similar shape and colour in co-blooming Iridaceae that offer nectar. The record of empidid fly pollination in *G. inconspicua* is also unusual, and may represent a purely opportunistic event. Too little is known about the role of Empididae in pollination.

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APPENDIX 1.—Keys to subgenera and species of *Geissorhiza*. Species numbers follow the classification in Table 1

Key to subgenera

- 1a Plants with concentric corm tunics, old tunics completely enclosed by new ones and layers splitting vertically from base or from apex, tunics usually brown and ± woody or ± fibrous; stamens always equal in length subgenus *Weihea*
- 1b Plants with overlapping corm tunics, old tunics pushed upward and fragmenting into tile-like segments from base, usually blackish and woody; stamens equal or unequal with one filament shorter than other two subgenus *Geissorhiza*

Key to *Geissorhiza* subgenus *Weihea*

- 1a Stamens and style included in lower half of perianth tube:
- 2a Leaves plane, 3–5 mm wide; flowers white 29. *G. esterhuyseiae*
- 2b Leaves with margins and central veins heavily thickened, 1.5–2.0 mm wide; flowers pink with dark markings at bases of tepals 30. *G. cedarmontana*
- 1b Stamens and style, or at least style branches, exerted from perianth tube:
- 3a Foliage leaf solitary and stem with scale-like, membranous bract in upper half 38. *G. unifolia*
- 3b Foliage leaves two or more in addition to scale-like bracts in upper half of stem:
- 4a Leaf blades spirally twisted; style usually dividing opposite base of anthers; flowering stems each with single flower:
- 5a Flowers yellow; perianth tube ± 3 mm long 25. *G. corrugata*
- 5b Flowers mauve; perianth tube 4–5 mm long 26. *G. spiralis*
- 4b Leaf blades more or less straight or falcate but not spirally twisted; style dividing opposite or beyond anthers; flowering stems with one to several flowers:
- 6a Corm tunics entirely of fibrous layers or softly membranous, either not accumulating or becoming fibrous with age:
- 7a Perianth tube 2–4 mm long; tepals 10–13 mm long:
- 8a Flower white to pale mauve-pink 43. *G. umbrosa*
- 8b Flowers deep blue to mauve or violet 44. *G. alticola*
- 7b Perianth tube 5–18 mm long; tepals 12–22 mm long:
- 9a Tepals 17–22 long; perianth tube 9–18 mm long, exerted from or included in bracts:
- 10a Perianth tube 10–18 mm long, well exerted from bracts; corm tunics of fine, netted fibres; leaves linear, 2-grooved on each surface with margins and central vein heavily thickened; plants of open rocky slopes 47. *G. nubigena*
- 10b Perianth tube 9–13 mm long, not or barely exerted from bracts; corm tunics soft-textured, soft-papery, not becoming fibrous; leaves linear, ± plane with margins and central veins moderately thickened; plants of waterfalls and wet, shaded rocks 6. *G. uliginosa*
- 9b Tepals 12–18 mm long; perianth tube 5–8(–10) mm long, not or barely exerted from bracts:
- 11a Perianth pink; plants 60–120 mm high; lower leaves prostrate, 20–50 × 2.5–6.0 mm, ± plane with thickened margins; flowering January 10. *G. altimontana*
- 11b Perianth mauve to violet; plants 100–300 mm high; leaves linear, 1–3 mm wide, 2-grooved on each surface with margins and central vein heavily thickened; flowering mostly late November and December:
- 12a Corm tunics finely fibrous; leaves 2–3 mm wide; flowers without pale throat; perianth tube 5–8(–10) mm long 45. *G. hesperantoides*
- 12b Corm tunics membranous; leaves 1.0–1.5 mm wide; flowers with pale throat; perianth tube 4–6 mm long .. 46. *G. cataractarum*
- 6b Corm tunics firm-papery to woody in texture, often drawn into bristles above:
- 13a Leaves not plane, either strongly ridged, or margins and central vein heavily thickened, or blade terete with 4 narrow longitudinal grooves:
- 14a Flowers moderate in size to large (tepals (14–)17–40 mm long), mostly whitish or cream-coloured to pink, usually darker pink on reverse; stamens unilateral and declinate; bracts acute (section *Engysiphon*):
- 15a Leaves not sticky, terete with hairline longitudinal grooves; perianth tube 12–20 mm long; tepals 20–30 mm long; plants of exposed rock outcrops only seasonally moist 5. *G. fourcadei*
- 15b Leaves sticky, sometimes only sheaths, blades always with margins strongly thickened or raised but if 4-grooved then grooves clearly visible:
- 16a Leaf blades with margins raised and winged but central vein hardly thickened, thus appearing H-shaped in cross section, marginal wings often curving inward and blade thus appearing terete:
- 17a Tepals linear or narrowly lanceolate, 3.0–4.5 mm wide, usually uniformly white 54. *G. tenella*
- 17b Tepals oblong to obovate, 4.5–7.0 mm wide, usually whitish flushed with pink or uniformly pink:
- 18a Perianth tube 15–30 mm long; spike borne on well-developed stem, (1)2–4(5)-flowered 53. *G. bonaspei*
- 18b Perianth tube 40–80 mm long; spike borne on disproportionately short stem, sometimes spike virtually at ground level, (1)–3(9)-flowered 55. *G. exscapa*
- 16b Leaf blades terete to linear or falcate, with both central vein and margins thickened and winged but visibly with 2 narrow grooves on each surface:
- 19a Perianth tube ± 8 mm long, included in bracts and about a third as long as tepals 49. *G. breviflora*

- 19b Perianth tube 20–50 mm long, reaching at least to bract apices or exceeding bracts and about as long as or longer than tepals:
 - 20a Tepals 17–27 mm long, white or barely flushed with pink 51. *G. longifolia*
 - 20b Tepals 28–40 mm long, pink or cream-coloured, becoming flushed with pink with age:
 - 21a Tepals slightly longer than perianth tube, 9–15 mm wide 50. *G. schinzii*
 - 21b Tepals shorter than perianth tube, 7–10 mm wide 52. *G. confusa*
- 14b Flowers small to moderate in size; tepals mostly 6–25(–30) mm long, either white to yellow, or blue or deep pink (whitish flushed pink in two species); stamens either symmetrically arranged or unilateral and declinate; bracts obtuse:
 - 22a Leaf blade terete with four hairline longitudinal grooves:
 - 23a Perianth tube elongate, 40–80 mm long 42. *G. stenosphon*
 - 23b Perianth tube short, 2–10 mm long:
 - 24a Flowers small, cream-coloured to yellow; tepals outspread when fully open, 8–14 mm long; perianth tube 2–3 mm long 39. *G. jumcea*
 - 24b Flowers moderate in size, pale to golden yellow; tepals often remaining cupped when fully open, 15–25 mm long; perianth tube 3–9 mm long:
 - 25a Flowers golden yellow; perianth tube 3–5 mm long 40. *G. furva*
 - 25b Flowers lemon yellow; perianth tube 7–9 mm long 41. *G. sufflava*
 - 22b Leaf blade linear to falcate with two visible, relatively wide longitudinal grooves on each surface:
 - 26a Flowers mauve, blue, purple or pink:
 - 27a Perianth tube 7–8 mm long; spike 1–4-flowered 31. *G. lithicola*
 - 27b Perianth tube 3–6 mm long; spike 4–10-flowered:
 - 28a Plants 150–350 mm tall; flowers pale mauve 32. *G. purpurascens*
 - 28b Plants 80–140 mm tall; flowers pale pink (darkening when dry) 48. *G. helmei*
 - 26b Flowers white to cream-coloured or yellow:
 - 29a Stem minutely hairy in upper half 37. *G. intermedia*
 - 29b Stem smooth:
 - 30a Flowers small; tepals 7–9 mm long 36. *G. pappei*
 - 30b Flower moderate in size, tepals 10–22 mm long:
 - 31a Bracts not normally sticky; perianth tube 9–11 mm long; flowers with dark centre 34. *G. darlingensis*
 - 31b Bracts sticky and usually with sand adhering; perianth tube 3–6 mm long; flowers uniformly coloured inside:
 - 32a Flowers whitish to cream-coloured, outer tepals usually flushed reddish outside; tepals 10–15 mm long and perianth tube 3–4 mm long 35. *G. hispida*
 - 32b Flower pale yellow; tepals 16–26 mm long, not normally flushed red on reverse, and perianth tube 5–6(–10) mm long 33. *G. humilis*
 - 13b Leaves plane or nearly so, margins and central veins only slightly raised:
 - 33a Flowers zygomorphic with stamens and style unilateral and declinate:
 - 34a Flowers purple or blue; tepals 12–18 mm long:
 - 35a Leaves prostrate, soft-textured; flowers blue-mauve; perianth tube \pm 3 mm long 12. *G. monticola*
 - 35b Leaves upright, firm-textured; flowers purple; perianth tube (5–)6–8 mm long 27. *G. karooica*
 - 34b Flowers pink with darker markings; tepals 22–32 mm long:
 - 36a Stems and leaves trailing; leaf blades soft-textured; perianth tube 10–13 mm long 4. *G. outeniquensis*
 - 36b Stems and leaves erect; leaf blades firm-textured; perianth tube 8–10 mm long 3. *G. rosealba*
 - 33b Flowers actinomorphic with stamens symmetrically arranged:
 - 37a Leaves linear to narrowly sword-shaped, mostly 1–2(–4) mm wide, never hairy even on margins; spike sometimes with only 1 or 2 flowers:
 - 38a Perianth tube 6–8 mm long, usually exerted from bracts; flowers white to cream-coloured, rarely pale yellow:
 - 39a Plants 40–80 mm high; stem rarely branched, never dichotomously 15. *G. setacea*
 - 39b Plants usually more than 120 mm high; stem usually dichotomously branched 20. *G. geminata*
 - 38b Perianth tube 2–5 mm long, included in bracts; flowers white, yellow or lilac:
 - 40a Flowers clear yellow; corms pointed at base or bell-shaped with flat base:
 - 41a Flowers cup-shaped; tepals 13–25 mm long; perianth tube \pm 4 mm long 18. *G. malmesburiensis*
 - 41b Flowers rotate when fully open; perianth tube 2–3 mm long:
 - 42a Style branches 2–3 mm long, filiform, ciliate with hairs shorter than width of style branch; tepals 6–12(–18) mm long; anthers 3–6 mm long 17. *G. ornithogaloidea*
 - 42b Style branches \pm 1.5 mm long, linear, conspicuously ciliate with hairs longer than width of style branch; tepals 6–7 mm long; anthers \pm 1.5 mm long 19. *G. platystigma*
 - 40b Flowers white or lilac; corms pointed at base:
 - 43a Flowers tiny, tepals 3–6 mm long; perianth tube 1.0–2.5 mm long 14. *G. nana*
 - 43b Flowers somewhat larger; tepals 6–12 mm long; perianth tube 2–5 mm long:
 - 44a Flowers pale lilac or purple; perianth tube 2–3 mm long; leaves soft-textured, spreading or prostrate 11. *G. delicatula*
 - 44b Flowers white; perianth tube 2–5 mm long; leaves firm, ascending to erect:
 - 45a Perianth tube 3–5 mm long; outer tepals rarely flushed red or purple outside; leaves \pm sword-shaped, 2–9 mm wide 13. *G. bracteata*
 - 45b Perianth tube 2–2.5 mm long; outer tepals red outside; leaves up to 1 mm wide, linear-falcate, exceeding the spike 16. *G. lapidosa*
 - 37b Leaves sword-shaped, lanceolate or ovate, (2–)3–10 mm wide, smooth or hairy, sometimes only on margins; spike often with more than 2 flowers:
 - 46a Basal leaves \pm upright:
 - 47a Perianth tube 8–10 mm long; flowers pale pink 2. *G. elsiiae*
 - 47b Perianth tube 2–6 mm long; flowers white, pink, or blue to violet:
 - 48a Plants branching mainly at base; flowering stems mostly 1- or 2(3)-flowered; flowers white, sometimes flushed red on reverse 13. *G. bracteata*
 - 48b Plants branching above ground level, or unbranched; flowering stems usually with at least 3 flowers and as many as 7:
 - 49a Flowers blue; leaf sheaths and sometimes proximal parts of blades and margins minutely hairy to pubescent .. 28. *G. pusilla*
 - 49b Flowers never blue; leaves entirely smooth or minutely hairy on margins:
 - 50a Leaves half to two-thirds as long as spike; flowers white or violet; tepals mostly 8–11 mm long, sometimes longer 1. *G. inconspicua*
 - 50b Leaves less than a third as long as spike; flowers mauve, pink or yellow to orange; tepals 13–17 mm long:
 - 51a Flowers deep yellow to orange, dark brown-maroon in centre 8. *G. tricolor*

- 51b Flowers pink or mauve, without dark centre:
- 52a Perianth tube 4–5 mm long; style branches ± 3 mm long 7. *G. foliosa*
- 52b Perianth tube 2–3 mm long; style branches 4–5 mm long 9. *G. nigromontana*
- 46b Basal leaves prostrate or inclined toward ground:
- 53a Perianth tube 10–30 mm long, as long as or longer than tepals; leaves usually broadly ovate and minutely velvety along margins 24. *G. ovata*
- 53b Perianth tube 1.5–8.0 mm long; leaves narrowly ovate to lanceolate, usually hairless:
- 54a Leaves firm-textured; cormlets never produced in aerial leaf axils:
- 55a Perianth tube 3–4 mm long; flowers creamy white to pale yellow; spike mostly 3–6-flowered 23. *G. parva*
- 55b Perianth tube 2.5–3.0 mm long; flowers white; spike 1- or 2-flowered 13. *G. bracteata*
- 54b Leaves soft-textured, often flaccid; cormlets borne in aerial leaf axils:
- 56a Flowers solitary on each flowering stem, lilac or blue 11. *G. delicatula*
- 56b Flowers usually more than one per flowering stem, white to pale yellow:
- 57a Stem either without or with only one cauline leaf; flowers fertile, capsules developing rapidly after flowering 21. *G. ovalifolia*
- 57b Stem bearing 2 leaves or more above ground level; flowers sterile, and cormlets produced in bract axils in place of capsules after flowering 22. *G. bolusii*

Key to *Geissorhiza* subgenus *Geissorhiza*

- 1a Stem minutely hairy, puberulous or pilose, sometimes only in lower part (hand lens usually needed to detect this character):
- 2a Perianth tube (6–)8–25 mm long:
- 3a Flowers pink; perianth tube 15–17 mm long; one filament shorter than other two 78. *G. silenoides*
- 3b Flowers blue to violet; filaments equal:
- 4a Perianth tube (6–)8–11 mm long; filaments 5–6 mm long 85. *G. namaquensis*
- 4b Perianth tube 18–23 mm long; filaments 8–10 mm long 86. *G. kamiesmontana*
- 2b Perianth tube less than 3 mm long:
- 5a Stamens unequal, one filament at least 0.5 mm shorter than other two:
- 6a Leaves ± plane with margins and central vein slightly to moderately thickened, but not obviously winged; margins and central vein smooth or minutely puberulous:
- 7a Perianth predominantly purple, pale in throat; short filament at least 4 mm shorter than long filaments; tepals 18–23 mm long 81. *G. inaequalis*
- 7b Perianth predominantly blue to violet or white; short filament no more than 2 mm shorter than long filaments; tepals 7–20 mm long:
- 8a Flowers radially symmetric except for eccentric style; tepals 7–11 mm long; flowers violet to pale blue or predominantly white:
- 9a Tepals mostly 11–14 × 4–6 mm; spike mostly with 3–7 flowers; anthers 3–5 mm long 79. *G. aspera*
- 9b Tepals ± 7 × 3.5 mm; spike with 1 or 2 flowers; anthers ± 2 mm long 80. *G. demissa*
- 8b Flowers zygomorphic with unilateral stamens and style; tepals 14–20 mm long; flowers predominantly violet with pale throat or pale centre edged in dark pigment:
- 10a Flowers with large pale, translucent centre edged with dark violet or red; filaments curved and slightly thickened in middle; spike with 1 or 2(–5) flowers; pollen usually red-brown or white 83. *G. monanthos*
- 10b Flowers violet with pale throat; filaments straight and filiform throughout; spike with 2–5 flowers; pollen pale mauve or white 82. *G. lewisiae*
- 6b Leaves with raised central vein (and sometimes secondary veins) bearing wings arching over leaf surface and margins with wings held ± at right angles to blade; wing edges smooth or ciliate to long-hairy:
- 11a Flowering stem with a short, membranous, scale-like bract in upper third sometimes subtending a branch:
- 12a Tepals 8–9 mm long; anthers ± 2.5 mm long 74. *G. scopulosa*
- 12b Tepals 10–22 mm long; anthers 4–6 mm long:
- 13a Style always short, dividing below level of anthers; flowers glossy pink to purple with dark centre; filaments, style and style branches dark purple 90. *G. cantharophila*
- 13b Style usually at least reaching to middle of anthers (occasional short-style plants may occur in some populations); flowers blue to violet, mauve or white with pale centre, often edged with darker colour, style and style branches white to pale blue or mauve:
- 14a Long filaments 10–12 mm long; basal leaves prostrate 91. *G. reclinata*
- 14b Long filaments 4–6 mm long; basal leaves erect to falcate 89. *G. heterostyla*
- 11b Flowering stem without a scale-like bract in upper third:
- 15a Leaves smooth or minutely hairy along margin edges; flowers blue or white 92. *G. arenicola*
- 15b Leaves conspicuously hairy along margin edges; flowers pale mauve, whitish, or pale pink:
- 16a Plants rarely higher than 80 mm; tepals 7–8 × 2–3 mm 97. *G. saxicola*
- 16b Plants (12–)16–30 mm high; tepals (13–)18–28 × 7–10 mm 99. *G. leipoldtii*
- 5b Stamens equal:
- 17a Leaves plane with margins and central vein slightly thickened but not winged; flowers zygomorphic with stamens and style uni-lateral and declinate; anthers and pollen brown:
- 18a Flowers white with reddish to brown-patterned centre 84. *G. tulbaghensis*
- 18b Flowers glossy dark blue-violet, pale in throat 93. *G. splendidissima*
- 17b Leaves with margins significantly thickened and/or raised into wings; flowers radially symmetric except for eccentric style; anthers and pollen not brown, usually white to yellow:
- 19a Leaf margins and central vein thickened, rendering blades 2-grooved on each surface; margins smooth not ciliate 75. *G. ciliatula*
- 19b Leaf margin edges raised at right angles to blade surface to form wings, these ciliate to hairy along edges:
- 20a Flowers small; tepals 6–8 mm long; anthers ± 2.5 mm long 98. *G. erubescens*
- 20b Flowers larger; tepals (13–)15–28 mm long; anthers (3–)6–8 mm long 99. *G. leipoldtii*
- 1b Stem smooth:
- 21a Stamens unequal, one at least 0.5 mm and usually more than 2 mm shorter than others; leaf margins lightly to moderately thickened but never raised into wings extended at right angles to surface:
- 22a Flowers small, with tepals 7–11 mm long:
- 23a Stem inclined to trailing, usually 1-branched, occasionally 2-branched; flowers white 73. *G. bryicola*
- 23b Stem erect, simple or usually 2- or 3-branched; flowers white or blue to violet:
- 24a Flowers blue to violet 72. *G. ramosa*
- 24b Flowers white 64. *G. minuta*

- 22b Flowers moderate in size to large; tepals (12–)14–30 mm long:
 - 25a Flowers creamy yellow with or without dark centre:
 - 26a Flower uniformly creamy yellow; tepals 18–28 mm long; stamens symmetrically arranged, longer filaments 7–9 mm long 61. *G. lonisabolusiae*
 - 26b Flower pale yellow with blackish centre; tepals 22–30 mm long; stamens unilateral and declinate, longer filaments 15–20 mm long 60. *G. barkerae*
 - 25b Flowers blue, purple, mauve, or pink:
 - 27a Perianth tube short, up to 3 mm long 71. *G. tabularis*
 - 27b Perianth tube 4–25 mm long:
 - 28a Leaf blades plane 76. *G. pseudinaequalis*
 - 28b Leaf blades with margins and central vein moderately to heavily thickened:
 - 29a Perianth tube 4–6 mm long 68. *G. burchellii*
 - 29b Perianth tube 10–25 mm long:
 - 30a Tepals 12–15 mm long 77. *G. rupicola*
 - 30b Tepals 22–30 mm long:
 - 31a Perianth tube 10–18 mm long; anthers and pollen yellow 69. *G. grandiflora*
 - 31b Perianth tube 22–25 mm long; anthers purple and pollen pinkish 70. *G. callista*
 - 21b Stamens equal in length; leaf margins either only lightly to moderately thickened or raised into wings held at right angles to surface and minutely hairy to hispid along edges:
 - 32a Leaf blades minutely to velvety hairy on veins and margins; bracts ± dry and rust-coloured distally at anthesis:
 - 33a Leaf blades with margins and central vein raised and winged, minutely hairy to pubescent on edges; stem without scale-like bract in upper half:
 - 34a Plants small, 70–120(–140) mm high; tepals ± 8 × 3–4 mm 96. *G. exilis*
 - 34b Plants mostly 150–250 mm high; tepals (8–)10–24 × 6–10 mm:
 - 35a Flowers white to cream-coloured; tepals (8–)10–18 × 6–7 mm; anthers 4–6 mm long 94. *G. inflexa*
 - 35b Flowers white to pink, red or purple; tepals 18–24 × 8–10 mm; anthers 7–8 mm long 95. *G. erosa*
 - 33b Leaf blades ± ribbed and velvety; stem with 1 or 2 scale-like bracts in upper half:
 - 36a Flowers ± white, outer tepals flushed reddish on reverse or uniformly blue; tepals ± 10 mm long 87. *G. divaricata*
 - 36b Flowers blue to mauve; tepals 12–17 mm long 88. *G. subrigida*
 - 32b Leaf blades not visibly hairy or minutely hairy; bracts remaining green or dry and pale distally:
 - 37a Leaf blades of lower two leaves linear or terete, margins and central veins moderately to heavily thickened, grooves between raised parts sometimes very narrow:
 - 38a Foliage leaves 2, upper one sheathing lower half of stem and with short free blade; stem bearing short, membranous, scale-like bract in upper half 57. *G. scillaris*
 - 38b Foliage leaves 3, sometimes the lowermost lost by flowering time; stem without scale-like bract in upper half:
 - 39a Leaf blades terete with 4 hair-like longitudinal grooves 62. *G. brehmii*
 - 39b Leaf blades with central vein and margins separated by wide grooves 56. *G. similis*
 - 37b Leaf blades of lower two leaves with two or more ribs (including central vein):
 - 40a Flowers white to pale yellow, sometimes with dark central mark:
 - 41a Tepals mostly 11–25 mm long and perianth tube mostly 4–8 mm long; tepals often flushed reddish on reverse, often without dark centre 58. *G. imbricata*
 - 41b Tepals mostly 10–16 mm long and perianth tube 2–4 mm long; tepals seldom flushed red on reverse and with dark centre:
 - 42a Spikes mostly 2- or 3-flowered, rarely more; perianth cream to yellow with dark brown to purplish centre 59. *G. purpureolutea*
 - 42b Spikes mostly at least 5-flowered; perianth uniformly white or cream 63. *G. sulphurascens*
 - 40b Flowers blue-violet with red centre:
 - 43a Stamens and style unilateral and declinate; style branches linear-filiform; red centre of flower edged in white 67. *G. radians*
 - 43b Stamens and style symmetrically arranged; style branches ovate-spathulate, about 2–3 × 2 mm; red centre of flower not edged in white:
 - 44a Perianth tube 6–9 mm long; anthers erect, borne below style branches 65. *G. eurystigma*
 - 44b Perianth tube up to 2.5 mm long; anthers arching inward, borne above style branches 66. *G. mathewsii*

Albuca crispa and *A. grandis* (Hyacinthaceae: Ornithogaloideae), two new species of subgenus *Albuca*, the rediscovery of *A. albucoides* (subgenus *Osmyne*), and the identity of *A. reflexa*

J.C. MANNING* and P. GOLDBLATT**

Keywords: *Albuca* L., *Drimia* Jacq., Hyacinthaceae, Ornithogaloideae, South Africa, taxonomy, Urgineoideae

ABSTRACT

Albuca crispa is a new species of section *Falconera* series *Trianthera* with crispulate leaves from the Great Karoo, known at least since 1947 but overlooked until now. A second new species, *A. grandis*, from the southwestern Cape was previously included in *A. fragrans* Jacq. (section *Falconera* series *Falconera*). It is a robust species that flowers in winter and early spring and the styles are rugulose with \pm isodiametric epidermal cells, unlike typical *A. fragrans* which is a more slender species flowering in early summer and with derived, smooth styles with fusiform epidermal cells. The recent discovery of a flowering population matching the type of *A. albucoides* (Aiton) J.C.Manning & Goldblatt (subgenus *Osmyne*) allows for a full description and illustration of this poorly known and taxonomically neglected species that has often been included in *A. suaveolens* (Jacq.) J.C.Manning & Goldblatt. Lastly, examination of the type of *A. reflexa* Krause & Dinter from Namibia shows it to be conspecific with *Drimia indica* (Roxb.) Jessop.

INTRODUCTION

Hyacinthaceae, which comprises 700–900 species of bulbous geophytes widely distributed through Africa and the Mediterranean, extending to Northern Europe, Asia and South America, is one of the larger geophyte families in southern Africa. The division of the family into the four subfamilies Hyacinthoideae, Ornithogaloideae, Oziroëoideae and Urgineoideae (Speta 1998; Manning *et al.* 2004) is now well established but generic circumscriptions in subfamily Ornithogaloideae in particular have undergone major revision since 1998 (Speta 1998; Manning *et al.* 2004, 2009). The description of *Ornithogalum* L. (Linnaeus 1753) was followed by that of *Albuca* L. (Linnaeus 1762), which was established to accommodate those species of *Ornithogalum* with distinctive *Galanthus*-like flowers in which the outer tepals are \pm spreading and the inner erect and \pm connivent. This distinction has been readily applied in most instances, with the notable exception of members of *Ornithogalum* subgen. *Osmyne* (Salisb.) Baker (Obermeyer 1978). The flowers of members of this group have fleshy, yellowish tepals with a dark median band that are highly reminiscent of flowers of *Albuca*, leading early workers to describe several species of this taxon in the latter genus.

The recent application of DNA techniques to the family suggested that neither *Albuca* nor *Ornithogalum* were monophyletic as then defined, leading Manning *et al.* (2004) to include both genera within a greatly expanded *Ornithogalum*. Further analysis provided greater resolution of relationships within the subfamily, enabling Manning *et al.* (2009) to develop a revised classification of the subfamily in which the genus *Albuca* is reinstated in a modified circumscription that includes several elements previously assigned to *Ornithogalum*, notably

subgen. *Osmyne* and most members of subgen. *Urophyllon* (Salisb.) Baker. In this circumscription *Albuca* is distinguished from *Ornithogalum* by thick-textured tepals with a broad median green band associated with a concentration of vascular traces around the midline, the style mostly longer than the ovary, and the generally larger seeds. This classification is followed here.

Within the enlarged circumscription of *Albuca*, those species previously treated as *Ornithogalum* subgen. *Osmyne* comprise *Albuca* subgen. *Osmyne* (Salisb.) J.C.Manning & Goldblatt and those of *Albuca sensu stricto* comprise subgen. *Albuca*.

1. Subgenus *Albuca*

Species of *Albuca* subgen. *Albuca* are distributed among the four sections *Albuca*, *Falconera* (Salisb.) J.C.Manning & Goldblatt, *Branciona* (Salisb.) J.C.Manning & Goldblatt (= sect. *Mitrotepalum* U.Müll.-Doblies ms.) and *Pallastema* (Salisb.) J.C.Manning & Goldblatt (Manning *et al.* 2009). The circumscription of these taxa at the level of subgenera was largely established by Müller-Doblies (1995), whose partial accounts of the species (Müller-Doblies 1994, 1995, 2006) constitute the most recent revisions of the group.

Albuca sect. *Falconera* comprises 18 species divided between the two series: *Trianthera* (U.Müll.-Doblies) J.C.Manning & Goldblatt (the outer whorl of stamens sterile); and *Falconera* (Salisb.) J.C.Manning & Goldblatt (both staminal whorls fertile) (Müller-Doblies 1995; Manning & Goldblatt 2006; Manning *et al.* 2009). Series *Trianthera* comprises just five species from eastern and southwestern South Africa. Several collections of a distinctive member of this series from the Great Karoo with unique, crispulate leaves represent an unnamed species that we describe here as *A. crispa*, making it the sixth member of the series.

Series *Falconera*, the largest of the two series in subgen. *Falconera*, currently includes 13 species from southern and south tropical Africa but is largely confined

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to the winter rainfall region of southern Africa, including southwestern Namibia. Floral morphology in sect. *Falconera*, in contrast to that in other sections in the subgenus, is relatively diverse, which enabled Müller-Doblies (1995) to identify significant interspecific variation in androecial and especially gynoecial morphology. Vegetatively the species in the section are almost evenly divided between those with leaves (and often peduncle) variously covered with glandular trichomes, and those with the vegetative parts completely glabrous. Among the latter, *Albuca fragrans* Jacq. and *A. clanwilliamae-gloria* U.Müll.-Doblies are considered to be sister species on the basis of their unique styler morphology. In most species of subgen. *Albuca* the epidermal cells of the style are \pm isodiametric but in these two species they are fusiform, giving the style a distinctive, longitudinally striate surface under magnification. This condition was first identified by Müller-Doblies (1995), who described the cells as prosenchymatous, a term originally applied to tissues of elongate cells concerned with the specialized functions of support, protection or conduction, in contrast to parenchyma, which is concerned with more generalized vegetative aspects. The term is thus conventionally applied to the vascular tissue and to supporting sclerenchymatous strands and although now generally obsolete, it is still used to described cells that are elongate and taper-pointed, thus spindle-shaped or fusiform (Eames & MacDaniels 1925).

Albuca clanwilliamae-gloria is one of the most distinctive species in the genus (Manning *et al.* 1999), readily recognized by its height and large, dull yellow flowers with suberect tepals. *A. fragrans*, in contrast, is far less distinguished and has until now included two very different elements. The first comprises slender, late-flowering plants with the distinctive fusiform styler cells that characterize the species. The second element consists of robust plants that flower in winter and early spring and have a rugulose style with \pm isodiametric epidermal cells. The latter plants are common and conspicuous along the West Coast and have been illustrated under the name *A. fragrans* in several popular accounts of the flora (Manning & Goldblatt 1994; Manning *et al.* 2002).

The type of *Albuca fragrans* is an illustration in Jacquin (1797) and although it is not possible to distinguish cellular details, the style is depicted as smooth, not rugulose. The rather elongate, slender inflorescence and the development of a secondary raceme are also consistent with *A. fragrans* as circumscribed by Müller-Doblies (1995). This fixes the application of the name *A. fragrans* to the more slender, late-blooming plants and excludes the robust, earlier-blooming plants with rugulose styles that were previously identified with the species.

Among the remaining species of sect. *Falconera* with glabrous leaves and rugulose styles, *Albuca papyracea* J.C.Manning & Goldblatt and *A. robertsoniana* U.Müll.-Doblies are characterized by a papery or fibrous neck sheathing the base of the stem and both are currently known only from the Robertson and Little Karoo; *A. bifoliata* R.A.Dyer from Grahamstown has unique, recurved stigmatic horns; *A. monophylla* Baker from southern Angola and Namibia has a single leaf and a style that is at least twice as long as the ovary; and *A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Gold-

blatt is a much smaller species from the southern Cape that flowers in late autumn and winter. The large West Coast taxon is accordingly described here as the new species, *A. grandis*. We provide a full description and illustration of *A. fragrans* for comparison.

***Albuca crispa* J.C.Manning & Goldblatt, sp. nov.**

Geophytum deciduum usitate 0.1–0.3 m altum, bulbo solitario subgloboso 25–30 mm diam., tunicis externis papyraceis, foliis 2–4 erectis ad basem caulem vaginantibus lineari-lanceolatis attenuatis forte undulato-crispatis, usitate 90–140 \times 3–10 mm, marginibus anguste hyalinis, inflorescentia 2–10-flora erecta, bracteis lanceolato-acuminatis, bractea inferiore ad 25 \times 5 mm, superiore 7–8 \times 4 mm, floribus pendentibus pedicellis arcuatis, tepalis albis vel cremeis carinis viridibus ad basem usque ad 1 mm connatis, externis anguste oblongis \pm 15 \times 4 mm apicibus papillatis, internis oblongo-ellipticis concavis 13–14 \times 4 mm apicibus cucullatis parum incrassatis, staminibus ad perianthium per \pm 1 mm adnatis, dimorphis erectis, externis sterilibus filamentis anguste lanceolatis \pm 11 \times 1.5 mm, internis fertilibus lateraliter expansis in quarta parte inferiore contractis \pm 9 \times 1.5 mm, antheris \pm 6 mm longis, ovario oblongo 3-alato \pm 5 mm longo breviter stipitato, stylo obpyramidali trigono transverse rugoso \pm 16 mm longo, stigma acuta trigona papillosa, capsulis ovoideis 3-angulatis \pm 14 \times 10 mm. Semina ignota.

TYPE.—Western Cape, 3222 (Beaufort West): Karoo National Park Camp at main entrance gate, 840 m, (–BC), 9 December 2005, Bester 6220 (NBG, holo.; PRE, iso.).

Deciduous geophyte, mostly 0.1–0.3 m high. *Bulb* solitary, subglobose, 25–30 mm diam.; outer tunics papery, greyish brown, inner tunics tightly overlapping, white, forming a translucent, papery collar around base of leaves, marked with transverse lines of thickening. *Leaves* 2–4, erect, slightly shorter than to \pm as long as inflorescence, fleshy, clasping stem at base, linear-lanceolate, mostly 90–140 \times 3–10 mm, attenuate, strongly undulate-crispulate, glaucous, margins narrowly hyaline. *Inflorescence* corymbose at first but elongating and becoming cylindrical, up to 60 mm long, 2–10-flowered; raceme erect, 1.5–3.0 mm diam. at base; bracts lanceolate-acuminate, lowermost up to 25 \times 5 mm, uppermost 7–8 \times 4 mm, prominently 3-veined, glaucous with narrow whitish margins; pedicels recurved at anthesis, 12–15 mm long, suberect to erect and lengthening in fruit, ultimately 25–30 mm long. *Flowers* pendulous on arching pedicels; tepals biseriate with blades of outer series overlapping inner, united basally for \pm 1 mm, white or cream-coloured with green keels, outer tepals narrowly oblong, \pm 15 \times 4 mm, apices papillate, inner tepals oblong-elliptical, concave, 13–14 \times 4 mm, apices cucullate, slightly swollen and fleshy with longitudinal band of papillae on outer face. *Stamens* adnate to perianth for \pm 1 mm, dimorphic, erect; outer stamens sterile, filaments narrowly lanceolate, \pm 11 \times 1.5 mm; inner stamens fertile, filaments laterally expanded and pinched in lower fourth, \pm 9 \times 1.5 mm; anthers \pm 6 mm long at anthesis, cream-coloured. *Ovary* oblong, 3-winged, \pm 5 mm long, shortly stipitate, paraseptal ridges diverging below; style obpyramidal, trigonous, transversely rugose, \pm 16 mm

long, acute with trigonous, papillate stigma. *Capsule* ovoid, 3-angled, $\pm 14 \times 10$ mm. *Seeds* unknown. *Flowering time*: late November and December. Figure 1.

Distribution and ecology: *Albuca crispa* appears to be endemic to the Great Karoo, where it has been found between Beaufort West, Graaff-Reinet and Steytlerville (Figure 2). It has been recorded on rocky flats, and flowers in midsummer.

Diagnosis and relationships: a very distinct species, *Albuca crispa* is characterized by its undulate-crispulate leaves, unique in the genus, and nodding, white and green flowers. The sterile outer stamens place it in the small series *Trianthera*. Among the five species currently recognized in series *Trianthera*, just one, *A. goswinii* U.Müll.-Doblies, is known with the combination of eglandular leaves and nodding flowers. Endemic to the coastal belt of the southwestern Cape, from the Hotentots Holland Mountains to Mossel Bay, it has leaves with straight margins, and yellow and green flowers

with unusual, lorate outer filaments. Glabrous leaves and nodding flowers are, however, probably ancestral in the subgenus and thus not necessarily indicative of a close relationship between species. Possibly more useful in this regard is flower colour. White and green flowers are relatively rare among the members of subgenera *Falconera* and *Albuca*, where yellow and green flowers are more normal. In section *Falconera* series *Trianthera*, white and green flowers are known elsewhere only in *A. decipiens* U.Müll.-Doblies, a species from Namaqualand and the Olifants River Valley. Although distinctive in its erect flowers, *A. decipiens* also shares with *A. crispa* the markedly obpyramidal style (rugulose in *A. crispa* and papillate in *A. decipiens*) with an apiculate stigma and diverging paraseptal crests, possibly indicative of a relationship between the two species.

Other specimens examined

EASTERN CAPE.—3223 (Rietbron): SW of Aberdeen, (–DB), 3 December 1950, *W.F. Barker* 7119 (NBG). 3224 (Graaff-Reinet): near Graaff-Reinet, (–AD), 2 December 1950, *W.F. Barker* 7095 (NBG).

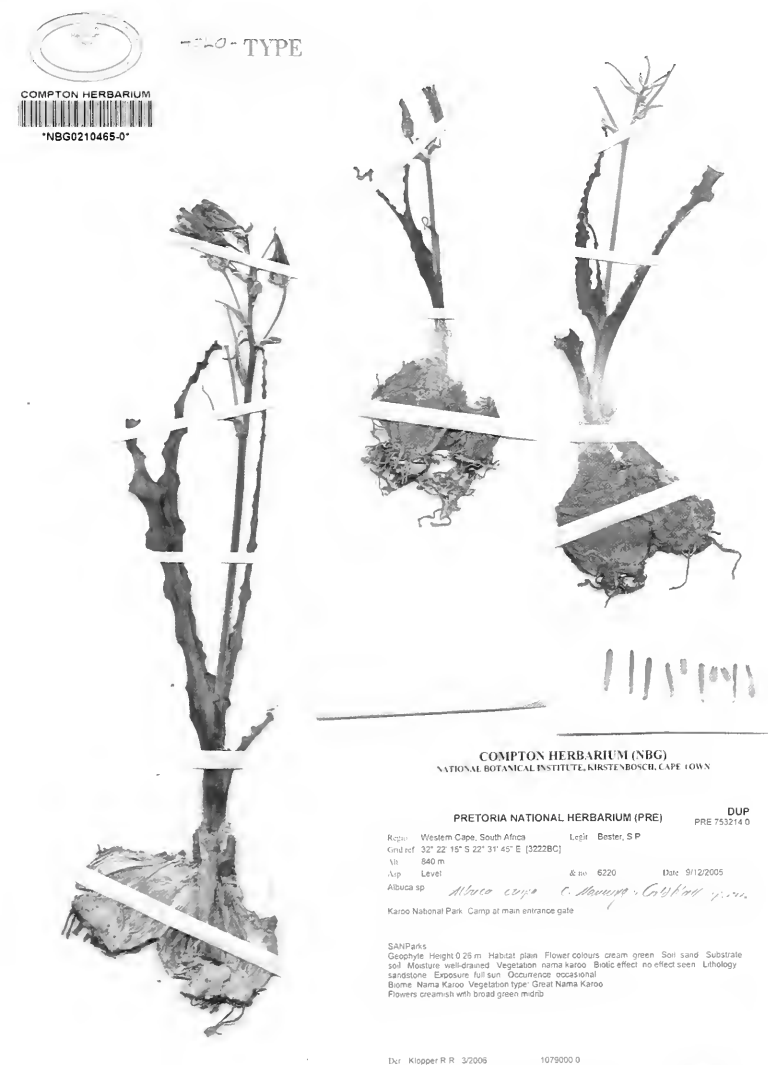


FIGURE 1.—*Albuca crispa*, holotype.

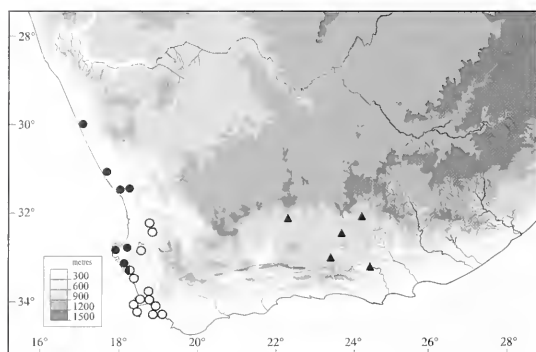


FIGURE 2.—Known distribution of *Albuca crisa*, ▲; *A. grandis*, ●; and *A. fragrans*, ○.

3323 (Willowmore): Miller, (–BB), 5 December 1947, W.F. Barker 9174 (NBG). 3324 (Steytlerville): Kleinpoort, (–BD), 2 December 1947, W.F. Barker 9173 (NBG).

Albuca grandis J.C.Manning & Goldblatt, sp. nov.

Geophytum deciduum 0.9–1.3 m altum, bulbo depresso-turbinato longitudinaliter striato 40–60 mm diam., tunicis membranaceis albescentibus, foliis \pm 4 erectis inflorescentia brevioribus succulentis lanceolato-convolutis, inflorescentia valida racemiformi congesta primo \pm 300 mm postremo ad 500 mm longa ad 50-flora (5)–8–15 mm diam. ad basem, bracteis lanceolato-acuminatis manifeste 3-venosis submembranosis postea siccis papyraceis, pedicellis primo suberectis per anthesin recurvatis 25–40 mm longis postremo 60–90 mm longis, floribus nutantibus vanillariodoris tepalis externis flavo-viridibus carinis viridibus internis albescentibus carinis viridibus, tepalis biseriatis connatis usque ad \pm 1 mm, externis per \pm 45° patentibus anguste ovato-oblongis 22–27 \times 8–10 mm apicibus papillosis, internis erectis leviter ringentibus oblongo-ellipticis concavis 20–25 \times 8–10 mm apicibus parum incrassatis tumidis externe vitta longitudinali papillarum, staminibus dimorphis erectis, externis filamentibus anguste lanceolatis in dimidio proximali canaliculatis 17–18 \times 2–3 mm antheris \pm 5 mm longis per anthesin cremeis, internis filamentibus lateraliter expansis infima quarta compressis 15–17 \times 3.5 mm antheris \pm 7 mm longis per anthesin cremeis, ovario oblongo 3-alato \pm 10 mm longo breviter stipitato porcis paraseptalibus parallelibus, stylo columnari trigono transverse rugoso flavo-viride \pm 12 mm longo, stigmathe trigono papilloso, capsulis ovoideis 3-angulatis 25–28 \times 15–20 mm; seminibus discoideis colliculatis ateribus \pm 6.5 mm diam.

TYPE.—Western Cape, 3318 (Cape Town): along R27 near Rondeberg, deep sandy soil in coastal scrub, (–AD), 30 August 2007, Manning & Goldblatt 3123 (NBG, holo.; MO, iso.).

Deciduous geophyte, mostly 0.9–1.3 m high. *Bulb* solitary or in small clusters, depressed-turbinate, 40–60 mm diam., longitudinally ribbed; outer tunics membranous, whitish, inner tunics tightly overlapping, white. *Leaves* \pm 4, erect, shorter than inflorescence, fleshy, clasping stem in basal half, lanceolate-convolute, attenuate, mostly 500–1 000 \times 30–40 mm, dull green. *Inflorescence* a stout, congested raceme, conical at first but

elongating and becoming cylindrical, \pm 300 mm when young but ultimately up to 500 mm long, up to 50-flowered; raceme erect when young but inclining slightly with age and flowers then subsecund, (5)–8–15 mm diam. at base; bracts lanceolate-acuminate, lowermost up to 50 \times 10 mm, uppermost \pm 20 \times 5 mm, prominently 3-veined, submembranous when young but soon drying and becoming papery and dark brown with broad whitish margins; pedicels recurved at anthesis, 25–40 mm long, suberect to erect and lengthening in fruit, ultimately 60–90 mm long, becoming subsecund through gradual inclination of the rachis during fruiting. *Flowers* pendulous on arching pedicels, vanilla-scented; tepals biseriate with blades of outer series overlapping inner, united basally for \pm 1 mm, outer tepals spreading at \pm 45°, narrowly ovate-oblong, 22–27 \times 8–10 mm, greenish yellow with green keels, apices papillate, inner tepals erect, gaping slightly, oblong-elliptical, concave, 20–25 \times 8–10 mm, whitish with green keels, apices slightly swollen and fleshy with longitudinal band of papillae on outer face. *Stamens* adnate to perianth for \pm 1 mm, dimorphic, erect; outer filaments narrowly lanceolate, channelled in basal half, 17–18 \times 2–3 mm with anthers \pm 5 mm long at anthesis, cream-coloured, inner filaments laterally expanded and pinched in lower fourth, 15–17 \times 3.5 mm, anthers \pm 7 mm long at anthesis, cream-coloured. *Ovary* oblong, 3-winged, green, \pm 10 mm long, shortly stipitate, paraseptal ridges parallel; style columnar, trigonous, transversely rugulose, yellowish green, \pm 12 mm long, acute with trigonous, papillate stigma. *Capsule* ovoid, 3-angled, 25–28 \times 15–20 mm. *Seeds* discoid, \pm 6.5 mm diam., colliculate, dull black. *Flowering time*: (late July) August to mid-October. Figure 3.

Distribution and ecology: distributed along the West Coast of Western and Northern Cape, with collections from north of Hondeklip Bay in central Namqualand as far south as Koeberg (Figure 2). The species is poorly collected despite, or more probably because of, its large size, and the exact extent of its range has still to be determined. *Albuca grandis* occurs in deep sandy soils, usually in coastal thicket and scrub where plants are often sheltered by bushes and shrubs.

Diagnosis and relationships: *Albuca grandis* is a robust species, typically reaching a metre or more in height, with a characteristic thick peduncle, usually more than 10 mm in diameter, and a dense, conical raceme of large, dull greenish white flowers with tepals 22–27 mm long. All six stamens are fertile, although the anthers of the outer whorl are \pm one third smaller than those of the inner whorl. The ovary is conspicuously 3-lobed, almost winged, with parallel paraseptal ridges, and a rugulose style. The bulb tunics are not at all fibrous. *A. grandis* is distinguished from other glabrous species of series *Falconera* with rugulose styles by its stature and the relatively early flowering, mainly in August and September.

The species has until now been confused with *Albuca fragrans* but the two differ in details of morphology and in ecology and phenology. Generally less than 800 mm tall, *A. fragrans* may reach up to 1 m but is always a slender plant with the rachis at most 5 mm in diameter. Its flowers are smaller than those of *A. grandis* in all respects and the inner tepals, which are deeply concave and almost saddle-shaped, are bright yellow distally,

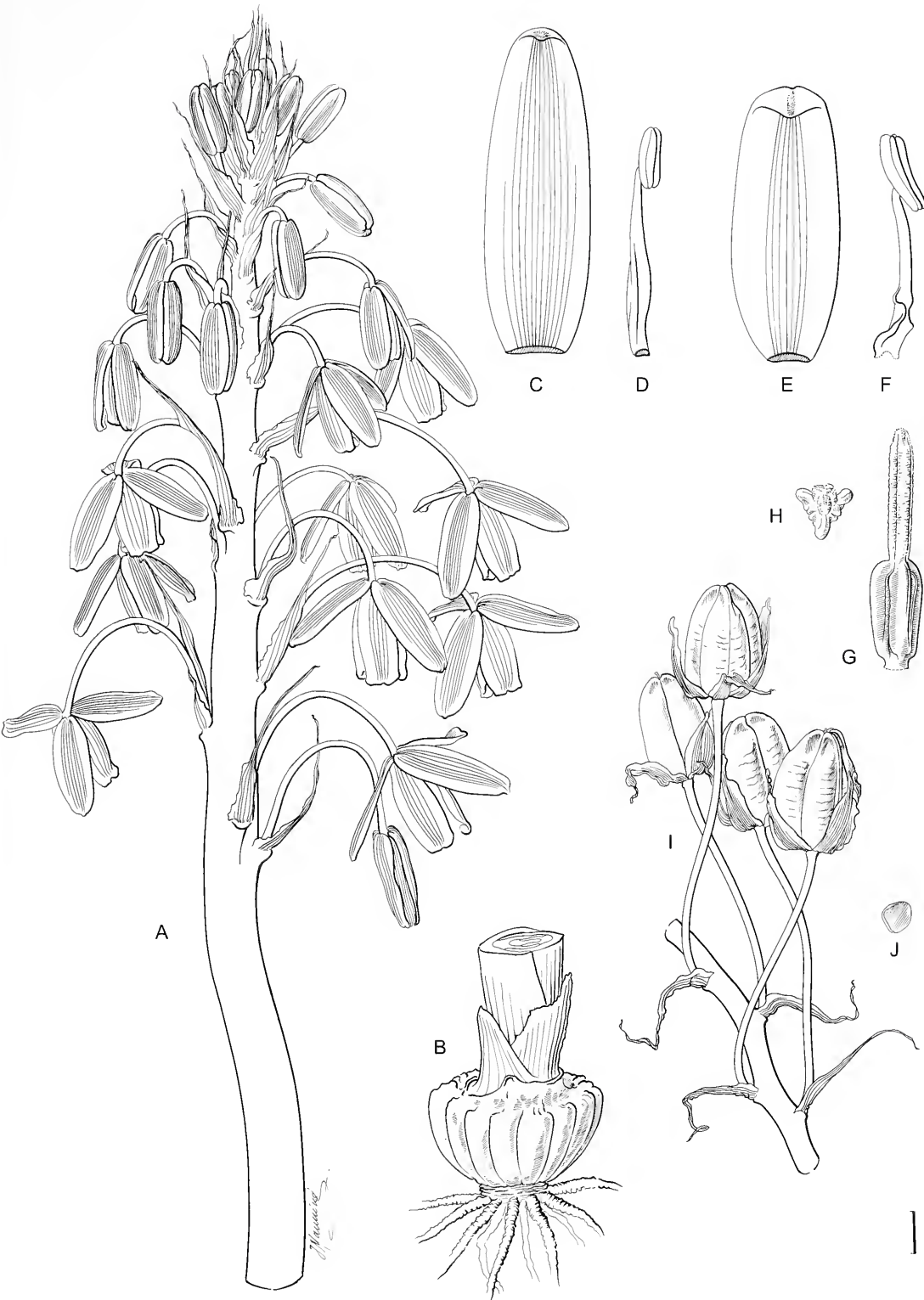


FIGURE 3.—*Albuca grandis*, Manning & Goldblatt 3123 (NBG). A, inflorescence; B, bulb; C, outer tepal; D, outer stamen; E, inner tepal; F, inner stamen. G, H, gynoecium: G, side view. H, top view. I, capsules; J, seed. Scale bar: A, B, I, J, 10 mm; C–H, 4 mm. Artist: John Manning.

unlike those of *A. grandis* which are shallowly concave and whitish. The most characteristic feature of *A. fragrans* is the style, which shows no trace of the rugulose epidermis of most species in the section and is, in contrast, smooth and covered with longitudinally fusiform epidermal cells. *A. fragrans* is a component of sandplain fynbos and flowers in late spring and early summer, in November and December.

The earliest collection of *Albuca grandis* that we have traced appears to be that made by horticulturist Harry Hall near Vredendal as late as 1970. Ready access to the coastal portions of the West Coast north of Yzerfontein was only possible after the completion of the R27 road in 1980 but even so the species is surprisingly poorly collected despite its large size, conspicuous inflorescence, and proximity to Cape Town.

Other specimens examined

NORTHERN CAPE.—3017 (Hondekliptaai): Kooigaas, Skulpfontein, dunes west of road, 200 m, (–AB), 24 August 1999, *Desmet 234* (NBG); S of Farm Rondawel on Groenrivier road, in woody succulent bushes in loose reddish sand, (–DB), 20 July 2005, *Snijman 2003* (NBG); Groen River Mouth, sandveld behind lighthouse, 10 m, (–DC), 15 August 2002, *Rourke 2253* (NBG).

WESTERN CAPE.—3118 (Vánrhynsdorp): 2 miles [3 km] NE of Vredendal, in deep red sandveld, (–DA), 22 July 1970, *Hall 3661* (NBG); Farm 246 north of Vánrhynsdorp, open shrubland, 184 m, (–DA), 12 July 2001, *Boucher 6733* (NBG); 10 km N of Vánrhynsdorp, deep red sand, (–DA), 18 November 1995 [fruiting], *Goldblatt & Manning 10408* (MO, NBG). 3217 (Vredenburg): coast south of Pater-noster, (–DD), 24 August 1997, *Goldblatt & Manning 10680A* (MO, NBG). 3218 (Clanwilliam): Velddrif, ± 6 km along road to Piketberg, sandy strandveld, ± 50 m, (–CC), 14 October 1986 [fruiting], *O'Callaghan 1239* (NBG).

Albuca fragrans Jacq., *Plantarum rariorum horti caesarei schoenbrunnensis* 1: 44 (1797). Type: South Africa, [Western Cape], without locality or date, illustration in Jacquin, *Plantarum rariorum horti caesarei schoenbrunnensis* 1: t. 84 (1797).

Deciduous geophyte, (25–)40–80(–1 000) mm high, usually with second inflorescence following first. *Bulb* solitary, depressed-globose or depressed-turbinate, 30–50 mm diam., longitudinally ribbed and wrinkled, developing numerous bulbils on surface and at base; outer tunics membranous, whitish, inner tunics tightly overlapping, white. *Leaves* 2–4(–6), erect, shorter than inflorescence, fleshy, clasping stem in basal half, linear-convolute, attenuate, mostly 200–600 \times 5–10(–25) mm, drying distally at flowering, bright to dull green, usually flushed dull red basally. *Inflorescence* a slender, moderately dense to lax, cylindrical raceme, ultimately up to 300 mm long, up to 20-flowered; raceme erect but nodding apically in bud, inclining slightly with age and capsules thus subsecund, 2–5 mm diam. at base; bracts lanceolate-acuminate, lowermost up to 25 \times 6 mm, uppermost $\pm 15 \times 5$ mm, submembranous when young but soon becoming papery, with ± 9 -veined central, brown portion and broad whitish margins; pedicels suberect in bud but recurved at anthesis, 12–25 mm long, becoming subsecund in fruit and suberect to erect, lengthening slightly and ultimately 20–30 mm long. *Flowers* pendulous on arching pedicels, vanilla-scented; tepals biseriate with blades of outer series overlapping inner, united basally for ± 1 mm, outer tepals spreading \pm horizontally or up to 30°, elliptical, 20–22 \times 8–9 mm, pale yellow with

green keels, apices papillate, inner tepals erect, gaping slightly, oblong-obovate, 15–17 \times 5–8 mm, deeply concave with margins \pm erect, pale yellow but bright yellow apically with green keels, apices fleshy and inflexed but not hinged with elliptical area of papillae on outer face. *Stamens* adnate to perianth for ± 1 mm, dimorphic, erect; outer filaments narrowly lanceolate-subulate, 12–14 \times 2 mm with anthers ± 4 mm long at anthesis, cream-coloured, inner filaments laterally expanded and pinched in lower fourth, $\pm 12 \times 2$ mm with anthers ± 6 mm long at anthesis, cream-coloured. *Ovary* weakly hourglass-shaped, 3-lobed, green, 6–8 mm long, shortly stipitate, paraseptal ridges parallel; style columnar, trigonous, longitudinally striate with testal cells fusiform, yellowish green, 8–9 mm long, obtuse with trigonous, papillate stigma. *Capsule* ovoid, 3-angled, 15–20 \times 10–15 mm. *Seeds* flattened, D-shaped, 4–5 mm diam., colluncate, dull black. *Flowering time*: late October to December. Figure 4.

Distribution and ecology: mainly coastal in the southwestern Cape, from north of Citrusdal in the Olifants River Valley southwards along the West Coast to the Cape Peninsula and eastwards to Kleinmond (Figure 2). The species grows in deep sand in sandplain fynbos.

Diagnosis and relationships: *Albuca fragrans*, along with *A. clanwilliamae*gloria, is distinguished from other species in the subgenus by its distinctive, smooth style with fusiform epidermal cells and a \pm acute stigma. The ovary is obscurely hourglass-shaped and the paraseptal ridges are parallel. Both species are also characterized by the development of numerous bulbils on the surface of the bulb. All other species in section *Falconera* have rugulose styles with \pm isodiametric epidermal cells.

Other specimens examined

WESTERN CAPE.—3218 (Clanwilliam): between Citrusdal and Clanwilliam, (–BD), 26 October 2001, *Manning 2651C* (NBG); Citrusdal, sand camp across from De Klerk Street, 170 m, (–CA), 29 October 1998, *Hanekom 3102* (NBG). 3318 (Cape Town): 2 miles [3 km] down new road from Yzerfontein, (–AC), 1 December 1970, *Barnard s.n.* (NBG); Darling District, Rondebosch Farm, (–AD), October 1998, *Manning 2184* (NBG); Cape Town, Rondebosch Common, (–CD), 20 November 2007, *Manning 3124* (NBG); Durbanville Racecourse, moist sandy flats, (–DC), 23 November 2004, *Ebrahim CR84* (NBG). 3418 (Simonstown): Silvermine, (–AB), 10 December 1944, *Compton 16613* (NBG); Steenberg, (–AB), 12 December 1945, *Compton 17866* (NBG); near Olifantsbosch, (–AC), 14 November 1945, *Leighton 1502* (NBG); Buffels Bay, (–AD), November 1935, *Compton 6383* (NBG); Cape Point, (–AC), 22 November 1941, *Compton 12525* (NBG); Strandfontein, near swamp, (–BA), 21 December 1941, *Compton 12790* (NBG); Seekoei Vlei, (–BA), 29 December 1917, *Purcell s.n.* (SAM98105); Gordons Bay, (–BB), November 1949, *Davis s.n.* SAM64681 (SAM); Cape Hangklip, near hotel, (–BD), 16 November 1963, *Rourke s.n.* (NBG). 3419 (Caledon): Kleinmond, Rooisand parking area east of town on lagoon, (–AC), 15 November 2007, *Manning 3122A* (NBG).

2. Subgenus *Osmyne*

Albuca subgen. *Osmyne* (Salisb.) J.C.Manning & Goldblatt [= *Ornithogalum* subgen. *Osmyne* (Salisb.) Baker] comprises ± 30 species from the winter rainfall region of southern Namibia and South Africa (Müller-Doblies & Müller-Doblies 1996; Manning *et al.* 2009). In the current classification of the subgenus, all but five of the ± 30 species of *Osmyne* are placed in section *Osmyne*, which is characterized by the presence of

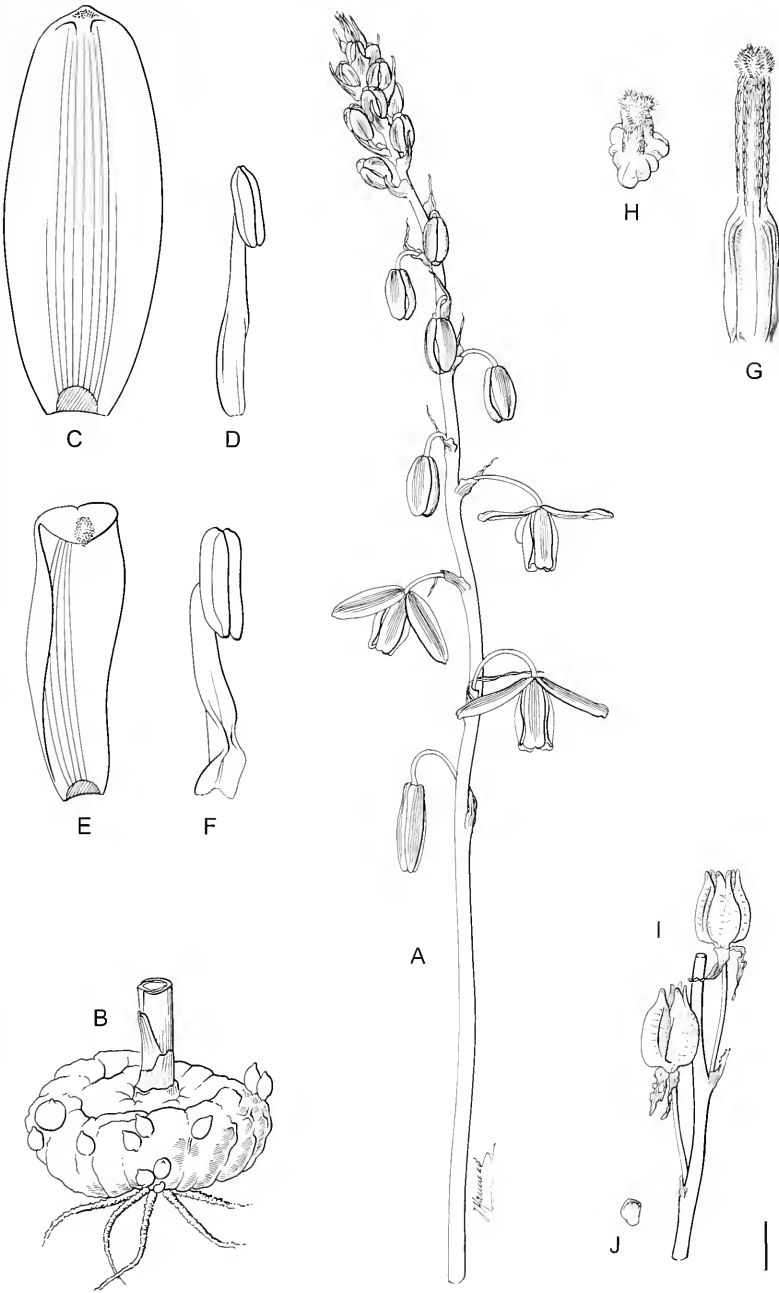


FIGURE 4.—*Albuca fragrans*, Manning 3124 (NBG). A, inflorescence; B, bulb; C, outer tepal; D, outer stamen; E, inner tepal; F, inner stamen. G, H, gynocium: G, side view; H, top view. I, capsules; J, seed. Scale bar: A, B, I, J, 10 mm; C–H, 3 mm. Artist: John Manning.

several, mostly narrow and not highly succulent leaves. Distinctions between many of these species are based primarily on differences in leaf number, orientation and morphology. The taxonomic treatment of the group by Obermeyer (1978) was hampered by inadequate collections of many of the taxa, with the result that species were often treated rather broadly. A more recent taxonomy of the group (Müller-Doblies & Müller-Doblies 1996) has benefited from much more extensive field knowledge but many of the species are not supported by adequate descriptions nor, in several cases, by the deposition of type specimens, making their assessment difficult if not impossible.

An extensive population of autumn- and early winter-flowering plants from the lowlands at the foot of the Elandsberg Mountains between Malmesbury and Tulbagh in Western Cape could not be assigned to any of the species of the subgenus generally recognized from the West Coast, and it was initially considered that they might represent an undescribed species. The leaves of these plants, which are absent or incompletely developed at flowering, number between 3–5, are erect and \pm subterete or terete, and the abaxial surface is adorned with longitudinal rows of minute papillae. Semi-terete forms have a translucent adaxial band down the middle of the blade and the margins are

scabridulous. The flowers are suberect but otherwise unexceptional in the group.

More than half of the species in subgen. *Osmyne* are confined to Namaqualand, with just five of the currently named species recorded in the southwestern Cape south of Clanwilliam. Among these, only *Albuca albucoides* (Aiton) J.C.Manning & Goldblatt (= *Ornithogalum albucoides* (Aiton) Thunb.) approaches the Elandsberg plants in having subterete or semiterete leaves, and is also reported to be hysteranthous. Non-flowering plants that are attributed to the species have been widely recorded by Müller-Doblies & Müller-Doblies (1996) along the West Coast, from the Bokkeveld Mountains to the Cape Peninsula but no specimens have been located in South African herbaria. Known in flower solely from the type, the species was included in *A. suaveolens* (Jacq.) J.C.Manning & Goldblatt by Obermeyer (1978) but was resurrected by Müller-Doblies & Müller-Doblies (1996). In the absence of any further collections, however, we continued to include the species in *A. suaveolens* (Manning & Goldblatt 2006).

Albuca albucoides is based on a single plant collected by Francis Masson from the Western Cape, most likely from either the Paardeberg near Malmesbury or from near Piketberg according to the conclusions of Müller-Doblies & Müller-Doblies (1996). The plant flowered in cultivation in Britain and the type specimen comprises five detached leaves and a single raceme. The date of flowering is given as September and October. This is almost certainly based on its flowering in cultivation in the northern hemisphere, which would correlate to March or April in the southern hemisphere. The leaves of the species are very characteristic at close inspection (Müller-Doblies & Müller-Doblies 1996), being semi-terete, 2–6 mm wide, stiff and succulent, shallowly canaliculate above, with an asperulous margin and with papillate ridges on the dorsal (sic) surface. This description is a perfect match for the Elandsberg plants, apart from the location of the papillate ridges on the morphologically ventral surface. Examination of the type specimen confirms that it matches the Elandsberg plants very well in the leaves and also in the few-flowered raceme with suberect flowers. There is thus no doubt that the Elandsberg plants represent the poorly understood *Albuca albucoides* and we take this opportunity of providing a full description and illustration of this 'lost' species.

Albuca albucoides (Aiton) J.C.Manning & Goldblatt in Taxon 58: 94 (2009). *Anthericum albucoides* Aiton: 449 (1789). *Ornithogalum albucoides* (Aiton) Thunb.: 62 (1794). Type: South Africa, [Western Cape], without precise locality or date, Masson s.n. ex cult. hort. Kew 1788 (BM, holo!).

Deciduous geophyte, 0.10–0.18 m high. *Bulb* solitary, pyriform, 12–20 mm diam.; outer tunics dry and thinly leathery, brownish, inner tunics tightly overlapping, white. *Leaves* absent or emergent at flowering, lateral to flowering stem and up to \pm half as long, 3–5, tufted, suberect, fleshy, not clasping below, terete or hemiterete and then adaxially flattened or weakly canaliculate with translucent median longitudinal strip, rounded abaxially with minutely scabrid longitudinal ribs, acute, 50–

80 \times 1.0–1.5 mm, dull green. *Inflorescence* a lax, erect raceme, 3–10-flowered; rachis 1.5–2.5 mm diam. at base; bracts lanceolate-acuminate, lowermost up to 12 \times 2.5 mm, sometimes with toothed basal auricles, uppermost \pm 10 \times 2 mm, submembranous when young but drying and becoming papery and dark brown with broad whitish margins; pedicels suberect in bud but curving apically at anthesis and flowers spreading, (8–)10–15 mm long, straightening and lengthening slightly in fruit, ultimately 15–25 mm long. *Flowers* held horizontally, rotate, lightly scented; tepals biseriate with outer series overlapping inner, united basally for \pm 0.5 mm, suberect in basal 1.5–2.0 mm then spreading, pale yellow with broad, \pm brown keels, outer tepals oblong-elliptical, 13–15 \times 2.5–3.0 mm, penicillate with conspicuously papillate-pubescent apex, with 5 centrally congested veins, outermost veins extending \pm halfway, inner tepals elliptical, 13–15 \times 3.0–3.5 mm, concave, apices swollen and fleshy and conspicuously papillate-pubescent, papillae separated by median glabrous band, with 3 centrally congested veins. *Stamens* adnate to perianth for \pm 1 mm, suberect; filaments awl-shaped, 4–5 \times 0.8 mm with anthers \pm 3 mm long at anthesis, yellow. *Ovary* ovoid, 3-angled, green, \pm 3 mm long, shortly stipitate; style slightly declinate, slender, 3-angled, \pm 4 mm long, acute with capitate, papillate-pubescent stigma. *Capsule* ovoid, 3-angled, 8–10 \times 6–7 mm. *Seeds* deltoid (rarely discoid), \pm 2 mm diam., colliculate, dull black. *Flowering time*: (late March) April (early May). Figure 5.

Distribution and ecology: thus far collections of flowering material of *Albuca albucoides* have been made at only two sites, one the type made in the late eighteenth century and the other the recent collections from Elandsberg Farm at the western foot of the Elandsberg Mountains east of Riebeeck-Kasteel (Figure 6). The type is thought to have been collected either on the Paardeberg near Malmesbury or near Piketberg (Müller-Doblies & Müller-Doblies 1996), and the two fully documented localities for the species are thus both from the small area along the West Coast known as the Swartland, between Malmesbury and Piketberg. Nonflowering plants, which were assigned to the species, have been collected from several additional localities along the West Coast, ranging from near Mamre in the south to Nieuwoudtville in the north (Müller-Doblies & Müller-Doblies 1996). The plants at Elandsberg occur in local colonies on stony alluvium in the highly localized Swartland Alluvial Fynbos vegetation (Mucina & Rutherford 2006). The nonflowering plants assigned to the species have been collected primarily from rock ledges in fynbos but also from deep sands and gravelly flats. The full extent of the range and ecology of *A. albucoides* remains to be adequately documented.

Flowering in the Elandsberg population takes place in the late autumn and early winter, from late March to early May, and we have observed more than one flush of emergence, presumably under the influence of environmental stimuli such as the passage of cold fronts. Early flowering plants appear without the leaves but those that are stimulated into flower later in the season are accompanied by the appearance of a tuft of young leaves lateral to the flowering stem. Seeds are shed soon after flowering, within two or three weeks, and thus plants with dehiscent



FIGURE 5.—*Albuca albucooides*, Manning 3175 (NBG). A, inflorescence and flowering plant; B, fruiting plant; C, outer tepal; D, outer stamen (lateral and adaxial view); E, inner tepal; F, inner stamen (lateral and adaxial view); G, gynoecium; H, seeds. Scale bar: A, B, 10 mm; C–H, 3 mm. Artist: John Manning.

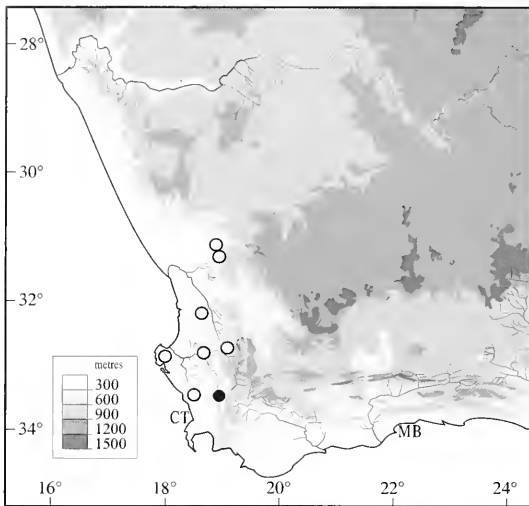


FIGURE 6.—Known distribution of *Albuca albucooides*. Flowering specimens, ●; and non-flowering collections cited in Müller-Doblies & Müller-Doblies (1996), O.

capsules can be found within the same population as those with emerging flowering stems. Most plants have dehiscent capsules and a well-developed tuft of leaves by mid-May.

3. *Albuca reflexa*

Albuca reflexa Krause & Dinter was based on a collection made by Dinter near Tsumeb in northern Namibia (Krause 1914). Examination of the isotype material at SAM, however, shows it to have the distinctly spurred lower floral bracts that are diagnostic for subfamily Urgineoideae (Manning *et al.* 2004), a feature that was overlooked in the original diagnosis. With the recent removal of the genus *Igidia* Speta to Ornithogaloideae (Wetschnig *et al.* 2007), Urgineoideae now comprises the two genera *Bowiea* Harv. ex Hook.f., characterized by a ramified, voluble inflorescence and long-lived flowers, and *Drimia* Jacq., with unbranched racemes of short-lived flowers. The racemose inflorescence of *A. reflexa*, combined with the shallowly campanulate flowers, are consistent with its placement in the genus *Drimia*. Among the southern African representatives of the genus, the relatively large flowers with narrow, recurved tepals, elongate filaments with \pm basifixed anthers, and the long pedicels > 20 mm long, place the species among the small group of taxa previously segregated as the genus *Thuranthos* C.H.Wright (Jessop 1977). Among these species the dimensions of the flowers of *A. reflexa* match those of *Drimia indica* (Roxb.) Jessop (Jessop 1977; Stedje & Thulin 1987). The narrow, linear leaves described in the description are consistent with this identification. Unfortunately the holotype, which presumably contained the bulb and leaves that were described in the protologue, could not be located at B, making it impossible to check for the characteristic mottling on leaf bases that is diagnostic of *D. indica* and the closely allied *D. angustifolia* Baker. The flowering specimens that constitute the isotype, however, are an excellent match with material of *D. indica* from South Africa. *D. indica* is widespread across the northern parts of South Africa, extending through tropical Africa

as far north as Ethiopia and Mauritania, and in India. It has been recorded from the northern parts of Namibia, in the Cunene Gorge and near Ondonga, and the type locality of *A. reflexa* at Tsumeb is little more than 100 km SE of the latter. We accordingly have no hesitation in regarding *Albuca reflexa* as a synonym of *Drimia indica*.

***Drimia indica* (Roxb.) Jessop**, in *Journal of South African Botany* 43: 272 (1977). *Scilla indica* Roxb.: 147 (1824).

Albuca reflexa Krause & Dinter in Krause: 445 (1914), syn. nov. Type: Namibia, Tsumeb, auf tiefgründigem Lehm Boden um kleine, flache Wassermulden, [without date], Dinter 2694 (B†, holo.; SAM, iso.! [2 sheets]).

ACKNOWLEDGEMENTS

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Taxonomy of the genus *Keetia* (Rubiaceae–subfam. Ixoroideae–tribe Vanguerieae) in southern Africa, with notes on bacterial symbiosis as well as the structure of colleters and the ‘stylar head’ complex

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Keywords: *Afrocanthium* (Bridson) Lantz & B.Bremer, anatomy, bacteria, *Canthium* Lam., colleters, *Keetia* E.Phillips, *Psydrax* Gaertn., Rubiaceae, taxonomy, Vanguerieae

ABSTRACT

The genus *Keetia* E.Phillips has a single representative in the *Flora of southern Africa* region (FSA), namely *K. gueinzii* (Sond.) Bridson. The genus and this species are discussed, the distribution mapped and traditional uses indicated. The structures of the calycine colleters, and the ‘stylar head’ complex which is involved in secondary pollen presentation, are elucidated and compared with existing descriptions. Intercellular, non-nodulating, slime-producing bacteria are reported in leaves of a *Keetia* for the first time. Differences between the southern African representatives of *Keetia*, *Psydrax* Gaertn. *Afrocanthium* (Bridson) Lantz & B.Bremer, and *Canthium* s. str., which for many years were included in *Canthium* s.l., are given.

INTRODUCTION

This paper is the first in a planned series on the classification of the *Canthium* s.l. group of the tribe Vanguerieae in southern Africa. This tribe of the Rubiaceae is notorious for the difficulties in resolving generic boundaries. For most of the 20th century the name *Canthium* Lam. was applied in a broad generic sense to a heterogeneous assemblage of taxa in southern Africa (Phillips 1951; Dyer 1975). Pioneering work initiated by Bridson (1985) was followed by several subsequent contributions advocating the recognition of various segregate genera. Evidence in support of the subdivision of *Canthium* s.l. has been forthcoming, amongst others, from anatomy and morphology (Tilney 1986), palynology (Tilney & Van Wyk 1997) as well as comparative molecular studies (Lantz & Bremer 2004). In this contribution we briefly review the generic treatment of *Canthium* s.l., followed by a taxonomic treatment of the genus *Keetia* E.Phillips for the *Flora of southern Africa* (FSA) region. Notes are also provided on the morphology and anatomy of the calycine colleters and ‘stylar head’ complex in *K. gueinzii*, as well as a first report on slime-producing bacteria in the leaves.

MATERIAL AND METHODS

Leaves, flowers in various stages of maturity, and fruits were selected for study (see below for voucher specimens). Fresh material was preserved in FAA; dried material was first rehydrated in distilled water and then placed in FAA. Transverse sections of fruits and lamina portions (of healthy leaves including portions with domatia, and of gall-infected leaves), as well as transverse and longitudinal sections of flowers, were prepared by embedding in GMA, sectioning with an ultramicrotome and staining according to the periodic acid/Schiff reaction, with tolui-

dine blue as counterstain (Feder & O’Brien 1968). Slides are housed at JRAU. For scanning electron microscopy, material was examined with a Jeol JSM 5600 scanning electron microscope after being coated with gold. Some sections of the ‘stylar head’ complex were treated with Sudan black and Sudan III to reveal any cutinization.

Voucher specimens (acronyms of herbaria as in Holmgren *et al.* 1990) are as follows:

Leaves: (lamina structure in t/s): Abbott 70 (PRU), Compton 3155 (PRE), Hafström & Acocks 1929 (PRE), Kok 712 (PRU), Van Wyk & Kok 5888 (PRU); (domatia): Thompson s.n. (JRAU), Tilney 267 (JRAU); (galls): Tilney 266 (JRAU); (stipules): Tilney 156, 267 (JRAU).

Flowers: (light microscopy): Burrows 9558 (BNRH+), Thompson s.n. (JRAU), Tilney 162, 267 (JRAU); (scanning electron microscopy): Thompson s.n. (JRAU).

Fruits: Abbott 70 (PRE), Hemm 45A (PRU), Kluge 25 (PRU), Kok 712 (PRU), Van Wyk 2702 (PRU), Van Wyk & Theron 4568 (PRU).

GENERIC CONCEPTS

The tribe Vanguerieae consists of about 600 species largely restricted to sub-Saharan Africa and Madagascar, but some are also found in southern Asia, the Pacific Ocean islands and Australia. Amongst the principal characters shared by members of the Vanguerieae are axillary inflorescences, flowers with corolla lobes valvate and thickened, stamens inserted on the rim of the corolla tube, single pendulous ovules in each locule of the ovary and fruit a drupe with one or more pyrenes. Most notable, however, are the anthers in the bud which are in close contact with a modified portion of the upper style, a so-called ‘stylar head’ complex (Igersheim 1993), where the pollen is deposited and which serves in secondary pollen presentation.

Canthium and *Vangueria* Comm. ex Juss. are among the oldest generic names in the Vanguerieae as currently delimited. The former is partly defined by having two

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locules and the latter five (Lantz *et al.* 2002). According to Bridson (1985), *Canthium s.l.* was a very heterogeneous group of species and she re-instated the genera *Psydrax* Gaertn. and *Keetia* (Bridson 1986) to accommodate several of the members. The distinctiveness of the leaf and young stem anatomy, pollen morphology and fruit structure of *Keetia gweinzii* (Sond.) Bridson from other southern African species of *Canthium s.l.* was shown by Tilney (1986). Using sequence data from the Internal Transcribed Spacer (ITS) region in the nuclear ribosomal DNA, Lantz *et al.* (2002) confirmed the separate generic status of *Keetia*. Their study also provided evidence that *Keetia* is one of the best-delimited genera in the Vanguerieae. In further studies, Lantz & Bremer (2004) added *trnT-F*

sequences from the chloroplast genome and morphological characters. *Keetia* was again shown to be monophyletic with strong support. Morphologically, *Keetia* species are climbers or scandent shrubs, rarely small trees, have a lid-like area on the pyrenes and, at least in the species examined, smooth retrorse hairs in the corolla tube.

The genus *Psydrax* is weakly supported as monophyletic in a molecular study (Lantz & Bremer 2004), but the species share a number of morphological (Lantz & Bremer 2004) and anatomical (Tilney 1986) synapomorphies. *Psydrax*, the most widely distributed genus of the tribe, is thought to be related to *Keetia* (Bridson 1985, 1986). The southern African representatives of

TABLE 1.—Distinguishing characters in southern African species of *Keetia*, *Afrocanthium*, *Canthium s. str.* and *Psydrax*

Characters	<i>Keetia</i> (<i>K. gweinzii</i>)	<i>Afrocanthium</i> (<i>A. giffillanii</i> , <i>A. mundianum</i>)	<i>Canthium s. str.</i> (<i>C. ciliatum</i> , <i>C. inerme</i> , <i>C. kuntzeanum</i> , <i>C.</i> <i>spinosum</i> , <i>C. suberosum</i> , <i>C.</i> <i>vanwykii</i>)	<i>Psydrax</i> (<i>P. fragrantissima</i> , <i>P.</i> <i>locuples</i> , <i>P. livida</i> , <i>P. obovata</i>)
Habitat	On forest margins	On rocky ridges, may also occur in forest; often in small groups	Variety of habitats although individual species may have restricted distribution	In bushveld or other regions with some individual species having a restricted distribution
Growth form	Robust climber or scrambling shrub	Tree or shrub	Tree or shrub	Tree or shrub
Duration	Evergreen	Usually deciduous	Usually deciduous	Usually evergreen
Spines	Absent	Absent	Present but may be mainly associated with coppice growth	Absent
Young plant parts	Covered in ginger-brown hairs	With whitish hairs	Glabrous	Glabrous or with whitish hairs
Side branches	Often subtended by smaller rotund leaves	Not subtended by smaller rotund leaves	Not subtended by smaller rotund leaves	Not subtended by smaller rotund leaves
Leaves				
length of blade	At least 70 mm but usually considerably more	Considerably less than 70 mm	Considerably less than 70 mm	Considerably less than 70 mm
texture	Thinly textured, ± leathery	Soft and easily wilting	Generally soft and easily wilting, rarely stiff and leathery	Generally stiff and leathery
base	Usually subcordate to cordate	Frequently tapering	Frequently tapering	Frequently tapering
stipules	Not keeled; without hair tufts inside	Usually slightly keeled; without hair tufts inside	Usually not keeled, occasionally slightly so; hair tufts present inside	Keeled, usually strongly so; without hair tufts inside
Domatia	Tufts	Tufts	Tufts, or pits sometimes with small hairs	Pits, pockets or domes with opening at top, sometimes with hairs
Flowers	In dense shortly-pedunculate clusters in leaf axils	Usually in small shortly-pedunculate clusters, rarely in dense clusters in leaf axils	Solitary or in small shortly-pedunculate clusters, occasionally in dense clusters in leaf axils	Usually in small shortly-pedunculate clusters, occasionally in dense clusters in leaf axils
Anthers	Fully exerted but rarely reflexed	Partially to fully exerted but never reflexed	Often only partially exerted and not reflexed	Exserted and usually reflexed
Style				
length	At least twice length of corolla tube	Slightly longer than corolla tube	Usually somewhat longer than corolla tube (in <i>C. kuntzeanum</i> ± as long)	Usually much longer than corolla tube
head	Distinctly longer than wide	Usually ± as long as wide	Usually wider than long	Usually longer than wide
Fruit				
shape	Globose	± globose, but reniform when single-seeded	Usually somewhat elongated	± globose
size	Relatively large	Relatively small	Varies from relatively small to relatively large	Relatively small
pyrene	With clear lid-like area across apex	Without clear lid-like area across apex	Without clear lid-like area across apex	Without clear lid-like area across apex
apical indentation	2-seeded fruit strongly or slightly indented	2-seeded fruit not or scarcely indented	2-seeded fruit strongly or slightly indented	2-seeded fruit not or scarcely indented
Seed: endosperm	Streaked with resinous granules	Not streaked with resinous granules	Not streaked with resinous granules	Not streaked with resinous granules

Psyrax and other taxa, at one time called '*Canthium*', will be discussed in future contributions. The genera *Psyrax* and *Keetia* are compared in Table 1.

Bridson (1987) divided the African *Canthium* species into four subgenera, one of which is *Canthium* subgenus *Afrocanthium* Bridson (Bridson 1987, 1992). The molecular studies of Lantz & Bremer (2004) also support *Canthium* subgenus *Afrocanthium* as being monophyletic and this subgenus was therefore given generic rank. Although *Keetia* and *Afrocanthium* (Bridson) Lantz & B. Bremer were strongly supported as sister taxa in these studies, the authors point out that the morphology gives little indication of this relationship—apart from a lack of white silky hairs inside the stipules of both *K. gueinzii* and *Afrocanthium mundianum* (Lantz & Bremer 2004: 274), but this character is shared with many other Vanguerieae genera (Bridson 1998). In characterizing *Afrocanthium*, Lantz & Bremer (2004) point out that it is geographically restricted to eastern and southern Africa (see Bridson 1992, Map 3). As a genus, *Afrocanthium* is further distinguished by the absence of a dark connective on the stamens, inflorescences borne at nodes from which the leaves have fallen, lenticels usually visible, and very short calyx limb tubes (Lantz & Bremer 2004). A comparison between southern African species of *Afrocanthium* and *Keetia* incorporating other characters is given in Table 1.

The elevation of *Canthium* subgenus *Afrocanthium* to generic level as *Afrocanthium* has assisted in lessening the heterogeneity of the remaining *Canthium* s.l. species, at least in southern Africa, but the latter still remains polyphyletic (Lantz & Bremer 2004). These researchers suggested that the genus *Canthium* s. str. should essentially be restricted to thorny members, i.e. those having paired, usually supra-axillary thorns. Also included in their concept of *Canthium* s. str. is the genus *Plectroniella* Robyns, a segregate based on the southern African *P. armata* (K. Schum.) Robyns, a species with the ovary plurilocular (the other taxa are bilocular). Since thorns are erratically present in some southern African members of the group, e.g. *C. inerme* (L.f.) Kuntze and *C. suberosum* Codd, this diagnostic character is more accurately expressed as *having the potential to produce thorns*. In the last-mentioned two species, thorns are either absent in some plants, or produced in juvenile plants or sucker shoots only. This is the sense in which *Canthium* s. str. has been used in Table 1. Note, however, that these spiny southern African species were kept as *Canthium* s.l. by Bridson (1992), as in her opinion they did not fully accord with the type of *Canthium*, namely *C. coromandelicum* (Burm.f.) Alston, from India.

TAXONOMIC TREATMENT

***Keetia* E. Phillips** in Memoirs of the Botanical Survey of South Africa No. 10: 587 (1926); E. Phillips: 369 (1927); Bridson: 967 (1986); Bridson: 362 (1998); Retief & Leistner: 487 (2000). Type: *K. transvaalensis* E. Phillips, now included in *K. gueinzii* (Sond.) Bridson.

Canthium sensu Sond.: 16 (1865) p.p., non Lam.; Hiern: 132 (1877) p.p.; Bullock: 360 (1932) p.p.; Phillips: 732 (1951) p.p.; Hepper: 180 (1963) p.p.; Dyer: 618 (1975) p.p.

Plectronia sensu auctt. div., non L.

The generic description below is for the genus as a whole and is largely based on Bridson (1986, 1998).

Climbers or scrambling shrubs, rarely small trees, evergreen; stems glabrous or frequently pubescent. *Leaves* not confined to new growth at ends of branchlets, petiolate, opposite, simple, margin entire; lamina chartaceous or occasionally coriaceous; those leaves subtending lateral branchlets often smaller and broader than main ones; stipules interpetiolar, lanceolate to ovate or triangular at base, not keeled, usually without white silky hairs inside. *Inflorescences* axillary, pedunculate and usually distinctly branched cymes; bracts and bracteoles often conspicuous. *Flowers* bisexual, 4–6-merous. *Calyx* with segments \pm equal to or sometimes longer than tube. *Corolla* whitish or yellow, cylindrical, tube with a ring of deflexed hairs, throat often pubescent or bearded, lobes usually \pm same length as tube, curving well backwards, often thickened towards apex. *Stamens* 5, attached in corolla throat; filaments moderately well developed; anthers partly or fully exerted, usually not reflexed, narrowly ovate or oblong. *Disc* nearly always puberulous to pubescent. *Ovary* 2-locular, with single ovule per locule, attached above middle of septum; style slender, \pm twice length of corolla tube; stigmatic knob ('stylar head' complex) cylindrical, conspicuously longer than wide, hollow to mid-point or to just below apex, apex slightly bifid at maturity. *Fruit* a 2-seeded drupe or often 1-seeded by abortion and asymmetric, slightly to strongly 2-lobed, somewhat laterally flattened, variously indented at apex, dark when mature; pyrenes woody or less often cartilaginous, usually \pm ovoid with ventral face flattened, somewhat colliculose, point of attachment either on ventral face shortly above centre or near apex; lid-like area completely or incompletely defined (but more clearly apparent from inside), either lying along ventral face above point of attachment, or across apex, provided with a central crest, presumably dehiscent around circumference on germination. *Seed* ovoid, shaped at apex according to position of lid-like area in pyrene, convoluted; endosperm streaked with patches of resinous granules (resembling a ruminant endosperm except that testa is never invaginated), or less often with resinous granules evenly dispersed or absent; testa thin, very finely reticulate; embryo straight with radicle erect, and small cotyledons lying parallel to ventral face of seed.

A genus of \pm 40 species, occurring in southern and throughout tropical Africa. Named after J.D.M. Keet (1882–1976), a South African forester and plant collector (Gunn & Codd 1981). Represented by *Keetia gueinzii* in the FSA region, a species common and widespread in Africa. *K. venosa* (Oliv.) Bridson is the only other species in southern Africa; it has been reported from Zimbabwe and Mozambique.

***Keetia gueinzii* (Sond.) Bridson** in Kew Bulletin 41: 970 (1986); Bridson: 911 (1992); Pooley: 478 (1993); Bridson: 363 (1998); Van Wyk & Van Wyk: 280 (1997); Tilney: 37 (2002), 19 (2003a), 28 (2003b); Coates Palgrave: 1101 (2002); Schmidt et al.: 628 (2002). Type: South Africa, Port Natal, *Gueinziius* 576 (P sheet P00551153!, lecto., here designated; sheet P00551152!, iso.).

Note: *Gueinzus* 71.576, as cited in Sonder (1850), is a typographical error; the full stop should be a comma, thus indicating two different gatherings. The other syntype, *Gueinzus* 71, could not be traced, unless this is the same as *Gueinzus* s.n. cited by Bridson (1986) as holotype, but considering the aforementioned comment, it should be a syntype.

Canthium gueinzii Sond. 54 (1850); Sond.: 16 (1865); Moore 40: 89 (1911); Bullock: t. 3170 (1932a); Bullock: 368 (1932b); Henkel: 147 (1934); Dale & Greenway: 428 (1961); White: 403 (1962); Palmer & Pitman: 2093 (1972); Compton: 580 (1976); Coates Palgrave: 881 (1977).

Plectronia gueinzii (Sond.) Sim: 241 (1907); Eyles: 493 (1916); Bews: 198 (1921).

K. gueinzii Von Breitenbach: 91 (1985), nom. invalid.

K. transvaalensis E. Phillips: 369 (1927), p.p., excluding syntypes Schlechter 12290 [PRE!; *K. venosa* (Oliv.) Bridson] and *Borle* 293 [PRE!; *K. zanzibarica* (Klotzsch) Bridson subsp. *cornelioides* (De Wild.) Bridson]. Type: South Africa, Transvaal, Barberton, woody ravines, *Galpin* 519 (K, lecto. !; PRE, iso.!).

Illustrations: Bullock: t. 3170 (1932a); Gibson: plate 102, 6 (1975); Bridson: 969, fruit (1986); Bridson: 358, fruit (1991); Pooley: 479 (1993); Van Wyk & Van Wyk: 281 (1997); Bridson: 364 (1998); Schmidt et al.: 629 (2002).

Robust climber or scrambling shrub, rarely a small tree \pm 3 m high; main stem faintly 4-angled, becoming dark brown to almost black, smooth to finely rough; branches long and trailing, with slender branchlets almost at right angles and sometimes slightly bending backwards, sparsely to densely covered with fine, brownish hairs; unarmed. *Leaves* oblong-lanceolate to ovate, 40–135 \times 28–60 mm but those subtending lat-

eral branches much smaller and often almost round, rather thinly textured, glossy dark green, usually drying brown, glabrous or very sparsely hairy adaxially, abaxially somewhat paler with sparse or dense rough hairs particularly on 6–9 pairs of lateral veins, with fine net-veining and hair-tuft domatia (Figure 1A, B); apex attenuate; base usually subcordate to cordate or sometimes rounded to truncate; margin slightly rolled under; petiole 3–13 mm long, hairy; stipules conspicuous, lanceolate to ovate, tapering to a point, 9–13 mm long, up to 6 mm wide at base, densely hairy on both surfaces but particularly on midrib where hairs longer and with tanniniferous substances when very young, becoming more sparsely hairy with most hairs confined to abaxial midrib when mature (Figure 2A, B), yellowish, falling early. *Inflorescence* in dense 20–50-flowered, branched axillary cymes; peduncle 5–15 mm long, at least initially pubescent; pedicels 3–7 mm long, pubescent to densely pubescent; bracteoles, linear-lanceolate to lanceolate, 3–6 mm long, hairy. *Flowers* usually produced in profusion, sweetly scented, 5-merous. *Calyx* with tube campanulate, 1–2 mm long, usually pilose below, glabrous above; calyx-limb obtuse, up to \pm 1.5 mm long, divided into teeth for \pm half its length, usually sparsely pilose to glabrescent and ciliate at apex; collectors present on adaxial surface, usually between calyx lobes, singly or in pairs, \pm squashed (Figure 2C–E). *Corolla* white at anthesis, fading to cream-coloured or pale yellow; tube 2.2–5.0 mm long, gradually widening upwards, glabrous without, with erect hairs at throat and deflexed hairs

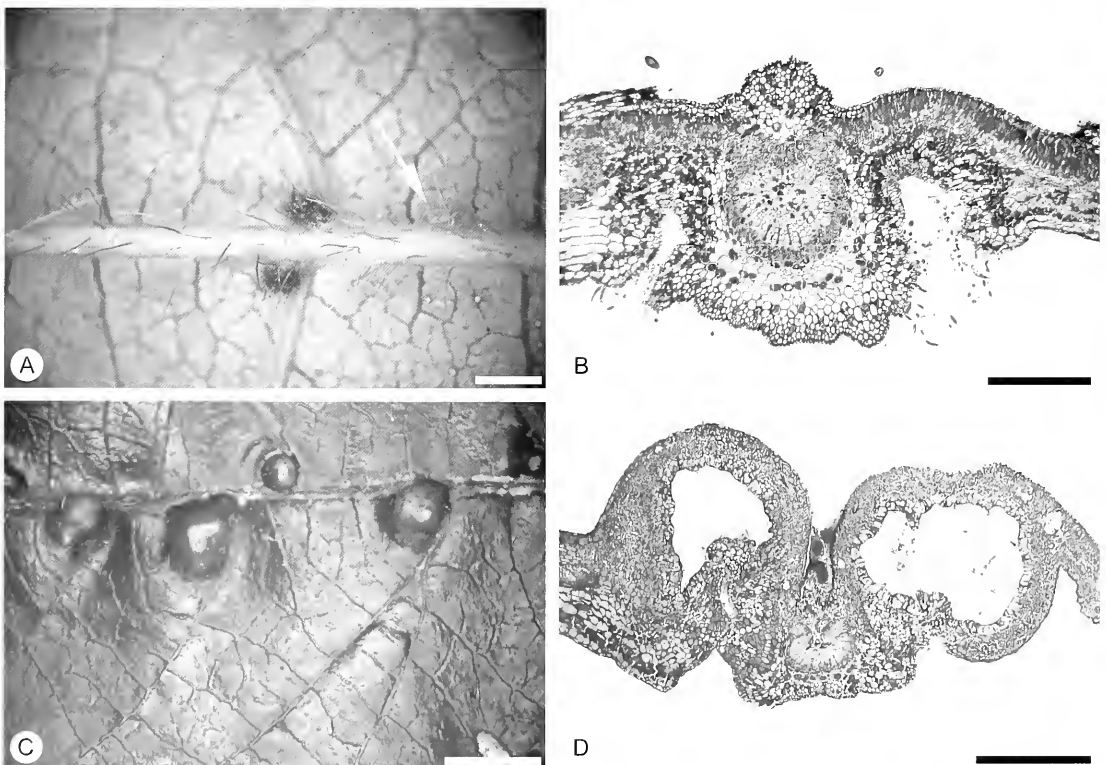


FIGURE 1.—*Kectia gueinzii*. A, hair-tuft domatia with a mite arrowed (*Thompson* s.n.); B, t/s of part of leaf showing domatia and vascular tissue of midrib in form of an arc with invaginated ends (*Tilney* 267). C, D, *Tilney* 266: C, portion of adaxial surface of leaf showing galls; D, t/s of midrib area and two galls. Scale bars: A, 1 mm; B, 400 μ m; C, 4 mm; D, 700 μ m.

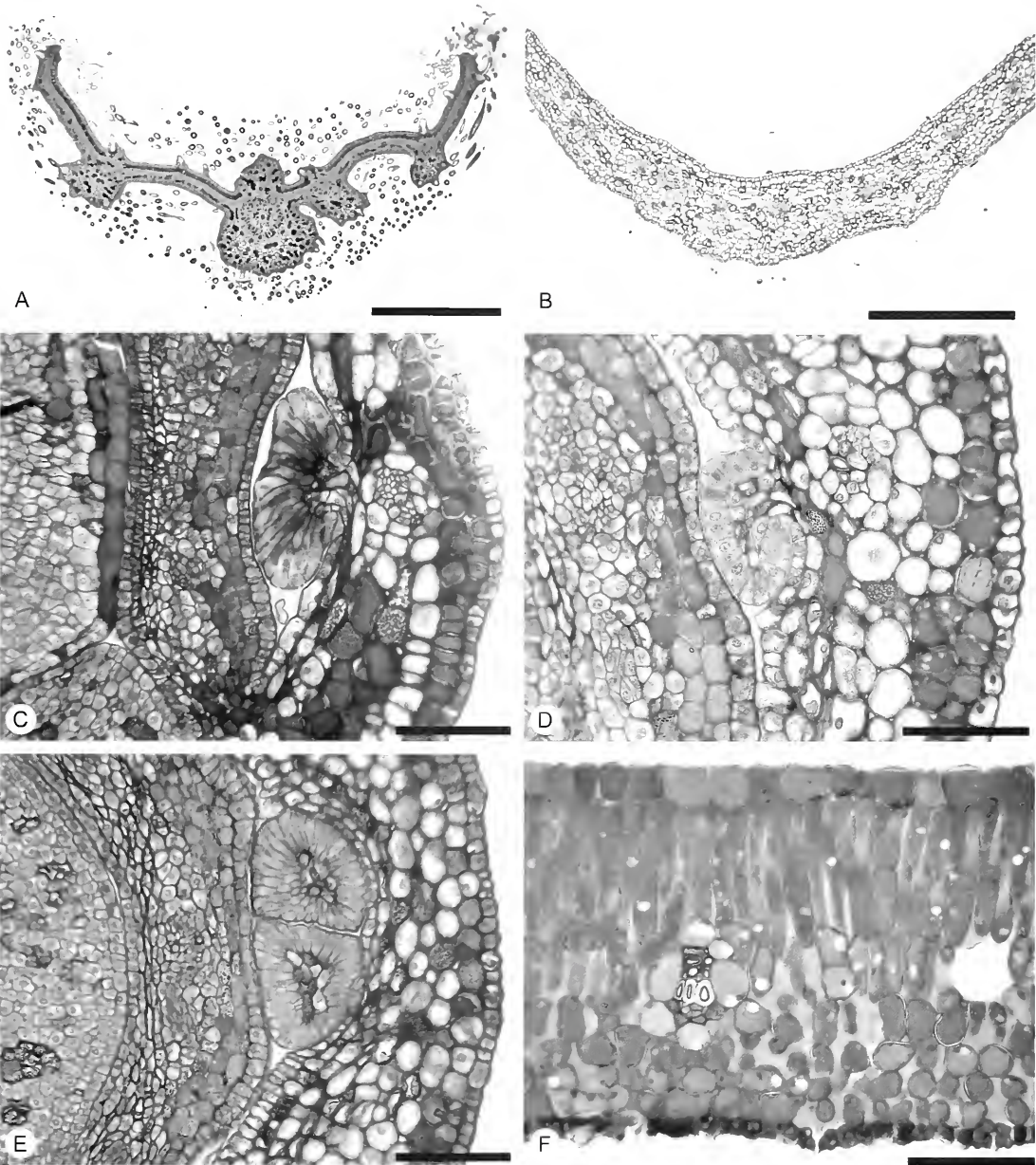


FIGURE 2.—*Keetia gueinzii*. A. *u/s* of very young stipule with abundant hairs on both surfaces (Tilney 156); B. *u/s* of portion of mature stipule showing sparse hairs mainly on abaxial surface (Tilney 267). C–E, Tilney 267: C, *l/s* of portion of bud showing calyxine colleter; D, colleters can clearly be seen to form as emergentia from sepals; E, *u/s* of portion of bud in which two calyxine colleters are visible. F, *u/s* of portion of lamina with slime-producing bacteria filling most of intercellular spaces (Van Wyk & Kok 5888). Scale bars: A, B, 700 μ m; C–E, 100 μ m; F, 70 μ m.

inside below throat; lobes spreading, oblong-lanceolate to ovate, 2.3–4 \times 1.2–2.3 mm, apex acute and thickened. *Stamens* adnate to corolla throat; filaments erect, 1.5–2.0 mm long; anthers fully exerted, \pm erect, 3 \times 1 mm, brown and shriveled at anthesis. *Disc* plane, \pm 0.5 mm wide, pubescent. *Ovary* with style linear, gradually tapering upwards, 5–10 mm long, pale green, glabrous; pollen presenter pale green, covered with yellow pollen, 1.8–2.3 \times 1.5 mm (Figures 3A, C–F; 4). *Fruit* single or 2-lobed, broadly oblong to roundish, 9–14 \times 7–14 mm, slightly indented, in dense, short-branched clusters, turn-

ing blackish, nearly always pubescent when immature becoming glabrous or very rarely possessing few hairs largely restricted to base in vicinity of pedicel; pyrene with lid-like area across apex. *Seed* with cotyledons orientated parallel to ventral face of seed; endosperm with tanniferous intrusions (Figure 5). *Flowering time*: September to November. *Fructing time*: October to May.

Etymology: the specific epithet commemorates Wilhelm Gueinzus (1814–1874), a German apothecary and naturalist who lived in KwaZulu-Natal from 1841 until his death (Gunn & Codd 1981; Hedge 1993).

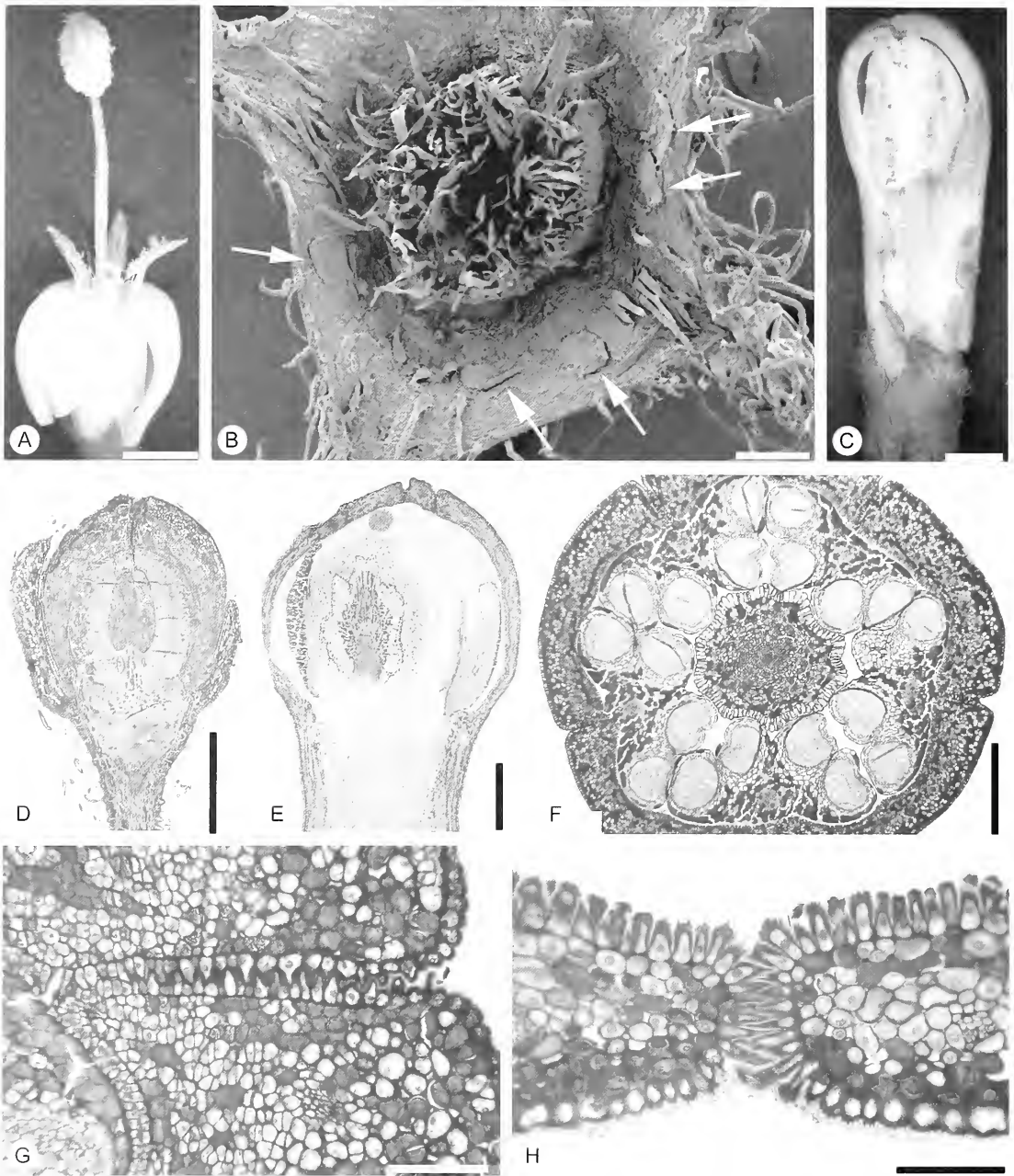


FIGURE 3.—*Kectia guenzii*. A–C, *Thompson s.n.*: A, flower showing characteristic secondary pollen presentation and hairs concentrated on sepal lobes; B, SEM micrograph showing appearance and position (singly or in pairs) of calycine colleters (arrowed), and pubescent disc; C, young bud showing pollen already deposited on 'stylar head' complex, closed stigma lobes and downwardly directed hairs in corolla tube. D, I/s of young bud showing flower structure and calycine colleter (*Tilney 267*); E, I/s of bud just prior to opening showing rare condition where style is looped such that stigma is near corolla throat (*Thompson s.n.*). F, G, *Tilney 267*: F, I/s of bud showing relationship between pollen sacs and furrows of 'stylar head' complex and large number of cells with tanniferous deposits on dorsal face of anthers; G, I/s of portion of corolla lobe showing 'unzipping' appearance where epidermal cells have elongated and formed thickened outer cell walls and cuticle. H, I/s of portion of corolla lobe showing how epidermal cells interlock at position where corolla lobes of bud will separate and open (*Burrows 5998*). Scale bars: A, 2 mm; B, 200 μ m; C, E, 1 mm; D, I, 700 μ m; G, H, 70 μ m.

Common names: *rankklipels*, *rankbokdrol* (Afrikaans); climbing turkeyberry, climbing kectia, climbing canthium, monkeyberry (English); *mudamhashoko*, *mudamhamashoko*, *imhlalalelingonyama* (Ndebele); *moekhutswane* (Northern Sotho); *ugenpe*, *sinwati* (Swazi); *muthambeni* (Venda); *mmynisilulube* (Xhosa); *ibinda*, *ugupe*, *mmiyisi* (Zulu).

Diagnostic features: in southern Africa this species has ginger-brown trichomes on the young plant parts, and also on the midrib and smaller veins on the abaxial sides of mature leaves, and petioles, pedicels and calyx lobes. The leaves are oblong-lanceolate to ovate with usually subcordate to cordate bases. The lamina is fre-

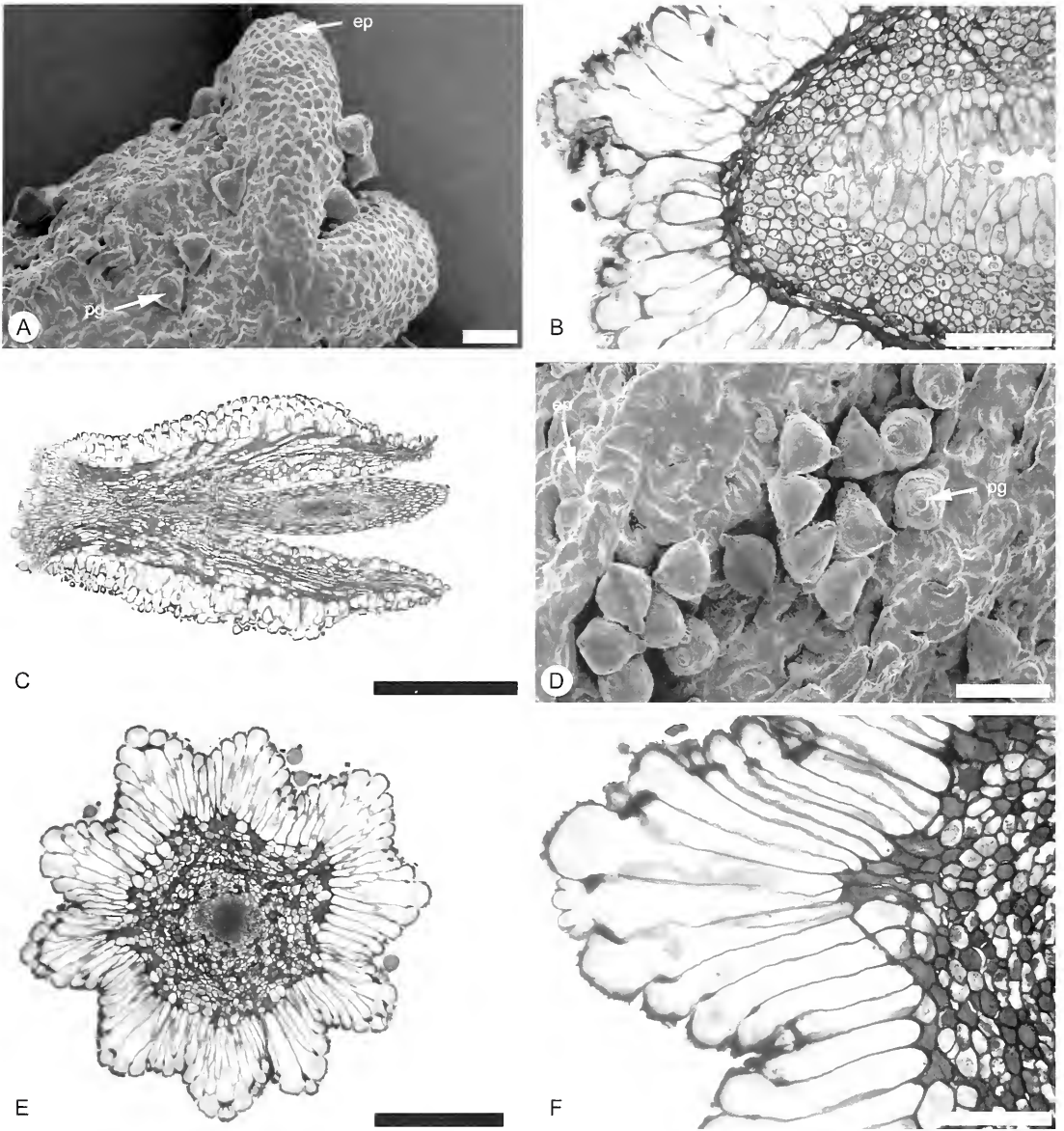


FIGURE 4.—*Keetia gueinzii*, Thompson s.n.: secondary pollen presentation. A, SEM micrograph of upper portion of 'stylar head' complex with two stigmatic lobes; B, t/s of 'stylar head' complex in region of stigma; C, l/s of 'stylar head' complex into which style is recessed; D, SEM micrograph of portion of 'stylar head' complex showing lobed epidermal cells and pollen grains in groove; E, t/s of 'stylar head' complex illustrating ten ridges and grooves, with cells forming ridges being much longer than those of grooves, and numerous tanniniferous subepidermal cells; F, t/s of portion of 'stylar head' complex showing elongated epidermal cells with dense cytoplasm, circular thickenings in more distal parts, and thicker cuticle over ridges than in grooves. ep, epidermal cells; pg, pollen grains. Scale bars: A, D, 50 µm; B, F, 100 µm; C, 700 µm; E, 400 µm.

quently at least 70 mm long, being glossy and glabrous adaxially. Stipules are conspicuous, lanceolate to ovate and sharply pointed. Hair-tuft domatia (Figure 1A, B) are associated with the axils of most major secondary veins.

Pollination syndrome: although secondary pollen presentation is a rather common phenomenon in the Rubiaceae, the presentation of pollen by a 'stylar head' complex (Igersheim 1993) to a pollinator is a unique characteristic of the tribe Vanguerieae (Lantz *et al.* 2002). Skottsberg in 1945 described the general anatomy

of this 'style-head'. The structure consists not only of stylar tissue but also of the stigmatic lobes and forms a swollen globose to cylindrical structure at the apex of the style into which the style is recessed (Figures 3A; 4C). In buds of *Keetia gueinzii*, the 'stylar head' complex forms ridges which fit into grooves between the two thecae of each anther and between adjacent anthers; there are thus ten ridges and ten grooves (Figure 3F). Just prior to the bud opening, the style elongates considerably, even rarely forming a loop so that the stigmatic surfaces are in close proximity to the corolla throat (Fig-

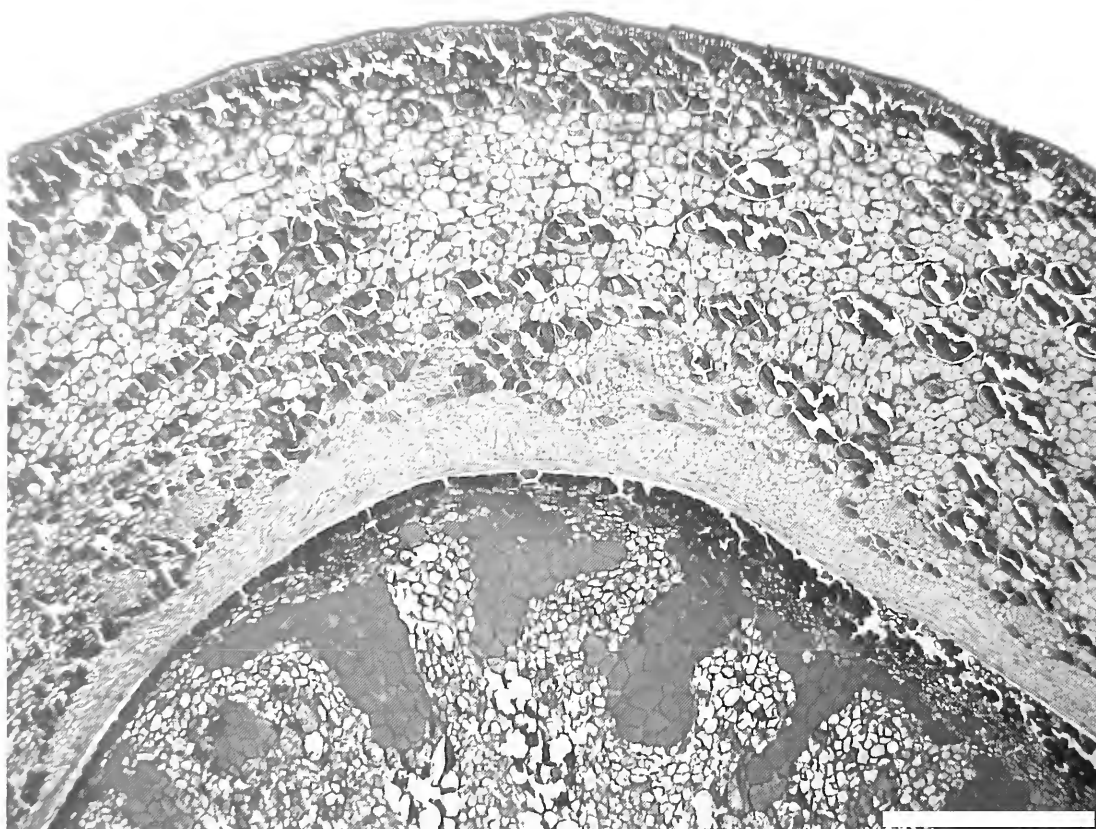


FIGURE 5.—*Keetia gueinzii*, Kok 712. Portion of pericarp and seed with endosperm showing tanniferous intrusions. Scale bar: 400 μ m.

ure 3E). The style and 'stylar head' complex is pale to bright green, the latter covered by yellow pollen. Floral structure suggests pollination by night-flying moths, but this needs confirmation, especially since pollination by beetles has also been suggested.

The 'stylar head' complex of *Keetia gueinzii* was studied using light (in t/s and l/s sections) and scanning electron microscopy (Figures 3; 4). The anatomy of this structure in *K. gueinzii* resembles that of *K. zanzibarica* (Klotzsch) Bridson subsp. *zanzibarica* and three species of *Vangueria* (Igersheim 1993) in the unusual elongated epidermal cells of the 'receptaculum pollinis' with circular thickenings towards the outer tangential walls, abundant tanniferous cells and conspicuous transmitting tissue in the style (Figure 3F; 4E). However, the lobed nature of the outer tangential portions of many of the elongated epidermal cells (Figure 4D, F) is a conspicuous feature not commented on previously, but visible in published photographs of longitudinal sections of *K. zanzibarica* subsp. *zanzibarica* (Igersheim 1993). In *K. gueinzii*, these elongated epidermal cells are densely cytoplasmic, especially distally, and droplet-like structures were frequently observed (Figure 4F). These cells are likely to produce a secretion to enable pollen grains to adhere to them. Sections were tested with Sudan black and Sudan III and the outer walls were found to be cutinized. A thicker cuticle was observed over the ridges than in the grooves. In transverse section, it can be seen that those cells forming the longitudinal ridges of the 'stylar head' complex are longer than those

in the grooves (Figure 4E, F). The circular thickenings are responsible for the bicellular appearance of many of the cells (Figure 4E, F).

Anatomy: detailed descriptions of the leaf (petiole, midrib and lamina) and stem anatomy, together with comparisons with other members of *Canthium* s.l., are given in Tilney (1986) and Tilney *et al.* (1988, 1990). Hairs, present on leaves, young stems, peduncles, pedicels and calyx lobes, are characteristically long, multicellular and highly tanniferous. They are usually inserted within a raised cluster of small epidermal cells. Hair-tuft domatia in which these hairs extend into the cavity of the domatium are shown in transverse section (Figure 1B). Different species of mites, of which one is shown in Figure 1A, were readily observed associated with them. In the petiole and midrib, the main vascular bundle is a distinctive arc with invaginated ends (Figure 1B). The first-formed periderm in stems originates cortically and in segments. Wood anatomy of some species, including *Keetia cornelia* (Cham. & Schltdl.) Bridson, *K. cf. gueinzii* (Sond.) Bridson and *K. cf. hispida* (Benth.) Bridson, is covered by Lens *et al.* (2000). All the features of the wood anatomy of these three taxa correspond with those of other members of the tribe Vanguerieae. The secondary xylem has been found to be homogeneous in this tribe.

Intercellular spaces in the mesophyll of healthy mature leaves may contain abundant non-nodulating, slime-producing bacteria (Figure 2F), here reported in

a member of *Keetia* for the first time. Hitherto this particular form of bacterial symbiosis was known only in the rubiaceaceous genera *Pachystigma* Hochst. and *Fadogia* Schweinf. (Van Wyk *et al.* 1990), both belonging to the Vanguerieae. The presence of these seemingly nonpathological bacteria, the functional significance of which remains a mystery, is easily overlooked in anatomical studies and their presence should be checked in other Rubiaceae.

Colleters are present, usually singly or in pairs (the so-called 'alternate' pattern of Simões *et al.* 2006), on the adaxial surface of the calyx usually between the calyx lobes (Figures 2C–E; 3B, D). They form as emergentia from the calyx lobes (Figure 2E). The main body (termed a 'head' by Thomas 1991) is undivided and is attached by means of a short stalk. Colleters are of the 'standard' type of Lersten (1974a, b), being composed of columnar epidermal cells not separated from each other and having a central parenchymatous axis. Epidermal cells have dark-staining materials adjacent to the cell walls (Figure 2C). During maturation of the colleters, the epidermal cells become more densely cytoplasmic and columnar. Colleters were not observed on the stipules. These secretory structures occur in a large number of rubiaceaceous species where they are usually associated with the stipules. They are believed to protect the developing shoot apex although other functions have been ascribed to them (e.g. Klein *et al.* 2004).

As mentioned above, valvate aestivation of the corolla lobes is a character of the tribe Vanguerieae. Furthermore, the margins of the lobes are thickened and usually thicker towards the apex. During development of the buds of *Keetia gueinzii* it was observed that the future epidermal cells, in the position where separation of the corolla lobes will take place at anthesis, initially elongate and interlock (Figure 3G, H). The outer periclinal cell walls of these cells gradually become thickened and striate, and a cuticle is deposited. Both these processes appear to facilitate the separation of the cells giving an 'unzipping' appearance.

Palynology: pollen is a pale yellow. SEM and TEM studies of southern African specimens (Tilney 1986; Tilney & Van Wyk 1997) revealed the following taxonomically significant characteristics of the pollen grains: a length (P) of (36–)40–45 µm, diameter (E) of 40–50 µm, suboblate to spheroidal shape, circular apertures, coarsely reticulate exine 2.6–4.2 µm thick with a sexine: nexine (S:N) of S = ± 2 x N, tectum thickness of 0.6–0.8 µm, nexine thickness of 0.5–1.2 µm, and the columellae 2 µm in height. Lens *et al.* (2000) also noted that the margin of the ecto-aperture is not obviously demarcated, and is circular, the sexine semitectate, the lumina elongated, the columellae long (± 2.7 µm) and widely separated. Apertures of fresh grains have prominent protruding onci—or so-called 'pollen buds' of some authors (Tilney & Van Wyk 1997; Dessein *et al.* 2005).

Distribution and habitat: occurs in Limpopo, Mpumalanga, Swaziland, KwaZulu-Natal and Eastern Cape (Figure 6), also northwards in Africa to Cameroon and Ethiopia. With *Keetia venosa*, it shares the distinction of being one of the most widespread species of *Keetia* in Africa. It is often locally common, occurring at the

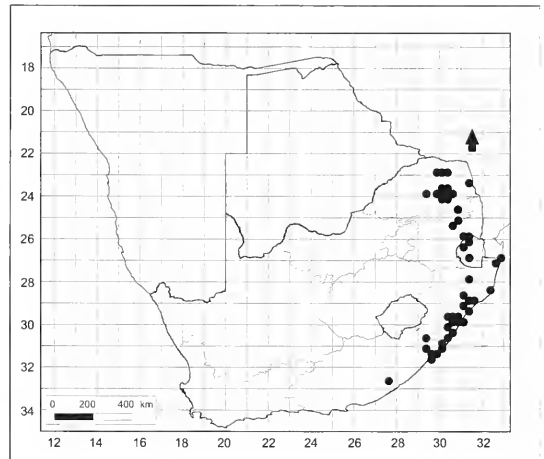


FIGURE 6.—Known distribution of *Keetia gueinzii* in the Flora of southern Africa region. Arrow indicates that its distribution extends further north into tropical Africa.

margins of and in evergreen forest and thickets, and in swamp forest.

Ecological significance and ethnobotany: used as knob-sticks in Swaziland (Dlamini 1981). Fruits are edible but astringent (Coates Palgrave 2002) and specifically eaten by the Luvale people (Watt & Breyer-Brandwijk 1962). Peters *et al.* (1992) also quote reports of fruits being eaten by baboons and chimpanzees as well as leaves and cambium by the latter. The Luvale use this species medicinally but no details are available (Watt & Breyer-Brandwijk 1962). The Swazi use the root medicinally (Dlamini 1981). Neuwinger (2000) refers to authors reporting that the leaves are pounded in a little water and the liquid drunk for epilepsy. Also, for hydrocele, a leaf infusion is drunk and used as a wash and, for colic, abdominal pain and nausea especially during pregnancy, and intestinal parasites, a leaf decoction is drunk. An extract of *Keetia hispida* (Benth.) Bridson has shown strong activity against Gram +ve bacteria (Koné *et al.* 2004).

A population heavily infested with galls has been recorded and a portion of a leaf showing these structures macroscopically and in transverse section is shown in Figure 1C, D respectively. In southern Africa the following ascomycete fungal pathogens have been recorded on *Keetia gueinzii* (Doidge 1950): *Balladyna tenuis* Hansf., *B. velutina* (Berk. & M.A.Curtis) Höhn., *Balladynocallia glabra* (Hansf.) Bat. (= *Balladynastrum glabrum* Hansf.) (all Parodiopsisaceae) and *Meliola littoralis* Syd. (Meliolaceae).

SPECIMENS EXAMINED (FSA region only)

Abbott 70 PRE, PRU; 3799, FSA?7251 PRU. Acocks 10957, 11805 PRE.

Balkwill & Cadnan 2016 PRE. Barnard & Mogg 17424 PRE. Borchards 55 PRE. Botha 2949, 3470, s.n. herb. No. 6071 PRE. Bower 9212 PRE. Brand, Bosch, Logie, Venter 342 PRE. Bredenkamp 1369 PRE, PRU. Buthelezi 301, 619 PRE.

- Canson & Irvine 95B PRE. Cloete 1913, 2085 NH. Codd 3056 PRE. Codd & De Winter 3087 PRE. Codd & Dyer 4516 PRE. Coleman 406 NH. Compton 2873d, 24756, 28200 NBG; 28218, 29120, 29476, 30658, 31551, 31719 NBG, PRE; 28734 PRE. Cooper 80 PRE.
- Davis 86 NH. De Winter 8255 PRE. De Winter & Vahrmeijer 8599 PRE. Dlamini s.n. PRE; s.n. NH; 38301, 43743, 49529, 57029 NBG. Doidge 6070 PRE.
- Eastwood 1284 PRE. Edwards 1308, 1381 PRE. Elan-Puttick 94, 142 PRE.
- Felton & Thornhill FSA347 PRU. Fitzsimons & Dam 26276 PRE.
- Galpin 519, 9397 PRE. Gerstner 4507, 5412 PRE; s.n. NH. Gordon 352 NH.
- Hafström & Acocks 1929 PRE. Hahn FSA327, 386 PRU. Heath 294, 518 PRE. Hemm 45, 45A PRE, PRU. Hobson 2054 PRE. Hutchings 3084 NH.
- Jacobsen 5305 PRE. Jordaan 3120 PRE. Junod 4152 PRE.
- Keet 1181, 1335 PRE; US15255 NBG. Kemp 1116 PRE. Kirkman 3057 PRE. Kluge 25, 1585 PRE. Korsten s.n. PRE. Krige 136 PRE.
- Law 70 NBG. Lawn s.n., 170 NH. Leighton 2982 PRE. Leistner, Thom & Gillham 3282 PRE. Lubke FSA262 PRU, NH.
- MacDevette 1542 PRE. Marloth 4095 PRE. McCallum s.n., 708 PRE. Meeuse 9394 PRE. Miller 8497, S/151 PRE. Mills 394 PRE. Moffet 1480 PRE. Mogg & Nicholson 37974 PRE. Moll 2196, 2298, 2722 PRE.
- Nel 350 PRE. NBG. Nicholson 102 NH.
- Obermeyer 859 PRE; TM30111.
- Pegler 2002 SAM. Plath s.n. PRE. Pole-Evans 3750 PRE. Pott TM13528. Poynton & Brent For. Herb. 11601. Prior 390 PRE.
- Rael 541 PRE. Rodin 4102 PRE. Rogers TM13870, TM18904, TM24016?, TM24426?.
- Sanderson 846 NH. Scheepers 362 PRE, PRU; 813 PRE. Scheepers & Haasbroek s.n. PRE. Schlechter 12290 SAM. Schmidt 28 NH. Sidey 3004 PRE. Sim s.n., 20215, 2392 PRE; 2393 SAM. Skott 1661 PRE. Smook 1267 PRE. Smuts & Gillett 3184 PRE. Stalmans 264, 593, 1117 PRE. Strey 6881 PRE, NH; 7152, 8510 PRE. Swynmerton 49 NH; 170 SAM, PRE.
- Thorncroft 372 PRE; 898 NH. Tilney 156, 162 JRAU, PRE, PRU.
- Vahrmeijer 510, 1476 PRE. Vahrmeijer & Tölken 927 PRE. Van der Schijff 4373, 4560, 6168 PRE, PRU; 4792 PRU. Van Jaarsveld 519 NBG, PRE. Van Jaarsveld, Van der Walt & Crous 32 PRE. P.van Wyk BSA349, BSA616 PRU. P.van Wyk & Hahn BSA838 PRU. Van Wyk 1640 PRE; FSA10424, FSA12215 PRU; 2174, 2702, 2966 PRE, PRU. Van Wyk & Kok 5888 PRE, PRU. Van Wyk & Theron 4568, 4569, 4872 PRE, PRU. Venter 89, 1858, 12661 PRE; 272, 438 NH. Victoria College (Stellenbosch) Herbarium US15254 NBG.
- Wager 23009 PRE. Ward 1086, CJ1525, CJ5243, CJ9888 PRE; 1647, MC1549 NH. Wells & Edwards 28 PRE. Wood s.n., 10378, 11392, 12773 PRE; ?3853 PRU; 305, 11356 NH; 5477 PRE, SAM. Whyte Herb. Musci Austro-Africani 16033 SAM. Whyte 8550 NH.
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Allioni's *Aloe* names (Asphodelaceae): nomenclature and typification

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Keywords: Allioni, *Aloe* L., *A. humilis* (L.) Mill., *A. maculata* All., *A. succotrina* All., *A. verrucosospinosa* All., chorology, nomenclature, taxonomy, typification

ABSTRACT

The taxa belonging to the genus *Aloe* published in *Synopsis methodica stirpium horti regii taurinensis* (Allioni 1760) and in *Auctarium ad synopsis methodicam stirpium horti regii taurinensis* (Allioni 1773) were examined. The protologues of *Aloe maculata* All. and *A. verrucosospinosa* All. are analysed and lectotypes designated. The homonymy of *A. succotrina* All. with *A. succotrina* Weston (1770) is recognized, and the lectotype of this last name designated. Epitypes are selected to fix the application of all three names. Short differential diagnoses of the three species are given and their distribution ranges discussed: distribution maps based on specimens held in the South African National Herbarium (PRE), KwaZulu-Natal Herbarium (NH), Compton Herbarium (NBG) and the South African Museum Collection (SAM) held in NBG are provided.

INTRODUCTION

Synopsis methodica stirpium horti regii taurinensis, published by Carlo Allioni (1728–1804) probably in 1760 (see Stafleu & Cowan 1976), is the first printed catalogue of the plants cultivated in the Botanic Garden of the University of Turin. The names of the species listed in this publication followed the binomial nomenclature system. For 88 of these, Allioni did not find a previously published binomial in the contemporary literature. Instead he gave them a number corresponding to a note. In this note he cited an earlier polynomial, when present, with the corresponding bibliographic citation, or he provided an original description in the absence of citations or as a complement to indications of previous authors. These nomenclatural gaps were later filled by Allioni in *Auctarium ad synopsis methodicam stirpium horti regii taurinensis* (1773, following Stafleu & Cowan 1976). In *Auctarium*, Allioni provided new binomials for 77 of the previously cited polynomials. Of these, 47 were based on descriptions provided by other authors (Dandy 1970).

Types of the taxa he described were checked among the ± 11 000 specimens of his herbarium (TO) (Dal Vesco 1986, 1992a, 1992b; Dal Vesco *et al.* 1988; Moraldo & Forneris 1988; Bechi & Forneris 1998; Selvi & Bigazzi 1998), containing also *exsiccata* prepared from plants in cultivation at the Botanical Garden of Turin.

In this paper, two binomials, *Aloe maculata* All. and *A. verrucosospinosa* All., published by Allioni in *Auctarium* for representatives of the Old World genus *Aloe*

L. (Asphodelaceae), are analysed and typified. Allioni also described *A. succotrina*, but this epithet was previously used, for the same taxon, by Weston (1770), thus Allioni's name is a homonym. Weston's name is here typified.

Each species is attributed to its correct taxonomic group and the nomenclature is updated. Diagnostic morphological characters are based on the current taxonomic circumscription of the species and geographical distribution maps are provided for each of the three species. These maps are based on specimens held in the South African National Herbarium (PRE), KwaZulu-Natal Herbarium (NH), Compton Herbarium (NBG) and the South African Museum Collection (SAM) held in NBG. All relevant literature was consulted and Allioni's herbarium examined. In addition, other collections preserved at TO (Bellardi's herbarium and TO-HG) that are taxonomically correlated to the species cited in these two catalogues were checked.

RESULTS AND DISCUSSION

A list of the species referred to the genus *Aloe* by Allioni is presented in Table 1. It includes the binomials published in *Synopsis* or in *Auctarium*, or, when no binomial was used by Allioni, his polynomials as cited in the notes in his books are given; information on the specimens in Allioni's herbarium is also presented. In *Synopsis*, 13 species are recorded. For four of these (*Aloe disticha* L., *A. spiralis* L., *A. retusa* L., *A. variegata* L.) Allioni used the Linnean binomial, whereas for the remaining nine he listed in a note the corresponding polynomials assigned by Dillen (1732), J. Commelijn (1697) and C. Commelijn (1701, 1703). Of these nine, three were not included in *Auctarium*: for *A. margaritifera* L., the Linnean binomial is applied; for *A. carinata* All. and *A. glauca* All., the binomials proposed had already been used previously by Miller (1768) (see Chiovenda 1912) and are illegitimate homonyms. A further binomial, *A. succotrina* All., still currently widely used (see for example Newton 2001a, b), is predated by *A. succotrina* Weston (1770), and is therefore an illegitimate homonym. Finally, *A. maculata* All. and *A. verrucosospinosa* [sic] All. are valid binomials.

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MS. received: 2008-11-24.

In Allioni's herbarium, specimens of two *Aloe* species were found which can be assigned respectively to *Aloe maculata* and to another species, only reported with the polynomial *Aloe africana flore rubro* ... in Allioni (1760), which could not be positively identified (see Table 1). No other specimens were found in Bellardi's herbarium and in TO-HG.

***Aloe maculata* All.**, *Auctarium ad synopsis methodica stirpium horti regii taurinensis* 5: 65 (1773). *Locus classicus*: *Sentina hujus plantae [] mittuntur ex Africa*. Lectotype, here designated: C. Commelijn, *Horti medici Amstelodamensis rariorum* 2: fig. 5 (1701) (Figure 1). Epitype, here designated: Pietermaritzburg, alongside the road between Bishopstowe and Hayfields, 29°37'13.05" S; 30°26'46.13"E, 18 August 2007, *Crouch 1138* (NH).

Taxonomic and nomenclatural notes: Allioni (1773) makes reference to a plate published in *Hortis medicis Amstelaedamensis* (C. Commelijn 1701: vol. 2, fig. 5), that referred to an *Aloe* described as *Aloe Africana cau-*

lescens foliis spinosis maculis ab utraque parte albican-tibus notatis. In Allioni's herbarium there is a specimen labelled *Aloe afric. coerulescens [sic] fol. spin. macul. ab utraq. parte albican-tib. notatis*. This is a candidate for a lectotype, however, it is not dated, thus it cannot be ascertained if it can be considered as original material in the sense of the ICBN (McNeill *et al.* 2006); there is also the difference in the wording, with *coerulescens* replacing *caulescens*, but this is probably simply a spelling error. Allioni's reference to the plate of excellent quality in C. Commelijn (1701) makes it preferable to designate this plate as the lectotype of *A. maculata*. Several authors (Dandy 1970; Webb 1980; Glen & Smith 1995; Newton 2001a, b; Smith & Van Wyk [B-E.] 1996; Smith & Van Wyk [A.E.] 2008) considered the use of Allioni's binomial as correct since it has priority over the other binomials. This view was not supported by the proposal made by Gilbert & Demissew (1997) to conserve the binomial *A. saponaria* (Aiton) Haw. (sub *A. saponaria* Haw.), which they suggested would maintain nomencla-

TABLE 1.—Species of *Aloe* included by Allioni in *Synopsis* (1760) and in *Auctarium* (1773) and Allioni's corresponding herbarium specimens

Synopsis methodica stirpium (1760)		Auctarium ad synopsisii (1773)			Allioni's herbarium
Binomial	Polynomial (footnote)	footnote/p.	Binomial	Polynomial (footnote)	footnote/p.
<i>Aloe disticha</i> (L.)		- (p. 56)			
<i>Aloe spiralis</i> (L.)		- (p. 56)			
<i>Aloe retusa</i> (L.)		- (p. 56)			
<i>Aloe variegata</i> (L.)		- (p. 56)			
	<i>Aloe africana sessilis foliis carinatis verrucosis</i> Dill. elth., p. 22	31 (p. 56)	<i>Aloe carinata</i>	<i>Aloe Africana sessilis foliis carinatis verrucosis</i> Dill. elth., p. 10	46 (p. 65)
	<i>Aloe africana humilis spinis inermibus et verrucosis obsita</i> Comm. prael., p. 77	32 (p.56)	<i>Aloe verrucosospinosa</i> [sic]	<i>Aloe Africana humilis, spinis inermibus & verrucosis obsita</i> Comm. prael., p. 77	47 (p. 65)
	<i>Aloe africana flore rubro folio maculis ab utraque parte albicantibus notato</i> Comm. hort. II, p. 15	33 (p. 56)			<i>Aloe fl. rubro fol. macul. ab utraq. parte albicantibus notato</i>
	<i>Aloe africana folio in summitate triangulari margaritifera flore subviridi</i> Comm. hort. II, p. 10	34 (p. 57)	<i>Aloe margaritifera</i> L.	<i>Aloe africana folio in summitate triangulari margaritifera flora</i> [sic] subviridi Comm. hort. II, p. 10*	51 (p. 65)
	<i>Aloe africana foliis glaucis margine, et dorsi parte superiore spinosis, flor. rubro.</i> Comm. prael., p. 75	35 (p. 57)	<i>Aloe glanca</i>	<i>Aloe Africana foliis glaucis margine, & dorsi parte superiore spinosis fl. rubro</i> Comm. prael., p. 75	50 (p.65)
	<i>Aloe africana canescens foliis spinosis maculis ab utraque parte albicantibus notatis</i> Comm. hort. II, p. 9	36 (p. 57)	<i>Aloe maculata</i>	<i>Aloe Africana calescens</i> [sic] foliis spinosis, maculis ab utraque parte albicantibus notatis Comm. hort. II, p. 9	49 (p. 65) <i>Aloe afric. coerulescens</i> [sic] fol. spin. macul. ab utraq. parte albicantib. notatis
	<i>Aloe africana canescens foliis glaucis brevissimis, foliorum summitate interna & externa nonnihil spinosa.</i> Comm. prael., p. 73	37 (p. 57)			
	<i>Aloe succotrina angustifolia spinosa flore purpureo.</i> Comm. hort. I, p. 91	38 (p. 57)	<i>Aloe succotrina</i>	<i>Aloe Succotrina angustifolia fl. purpureo.</i> Comm. hort. I, p. 91	48 (p. 65)
	<i>Aloe foliorum margine luteo.</i>	39 (p. 57)			

*, *Aloe pumila* L. var. *a. margaritifera* L. (*Species plantarum* 1753: 322).

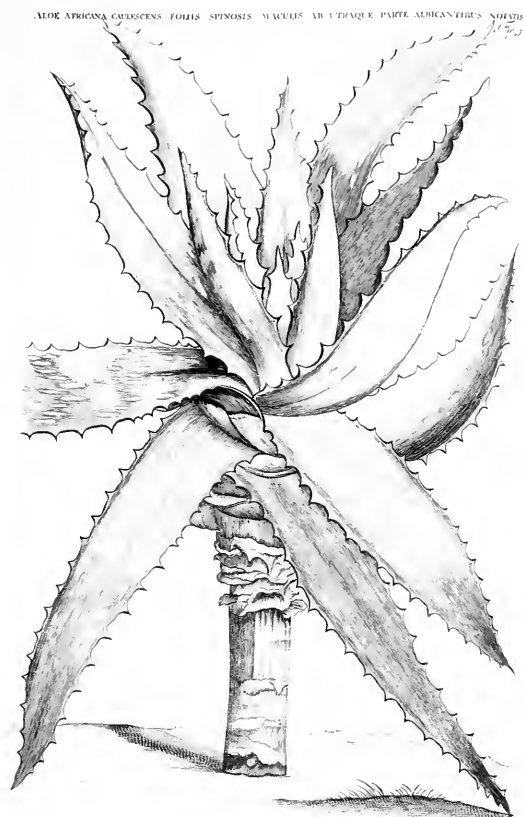


FIGURE 1.—*Aloe africana caulescens foliis spinosis maculis ab utraque parte albicantibus notatis* (= lectotype of *Aloe maculata* All.). In C. Commelijn, *Horti medici Amstelodamensis. Pars altera*. Blaeu, Amstelodami, 1701, fig. 5.

tural stability, as this binomial is better known than Allioni's. Nevertheless, *A. saponaria* has not been conserved (McNeill *et al.* 2006: art. 14). Chiovenda (1912) gave *A. obscura* Mill. (1768) as the accepted name considering *A. maculata* to be a synonym. This view has not been followed by any other authors and the correct application of the epithet *obscura* remains doubtful (Stungo 1996). At present, the binomial *A. obscura* is considered to be of unresolved application, and it may refer either to a variant of *A. maculata* (and then becoming the accepted name, taking precedence over *A. maculata*) or to a hybrid, with *A. maculata* as one of the parents. However, no plants are known in South Africa that can be matched to this species or to Miller's description, and no specimens, nor natural population, has been found which could allow us to make a comparison (L. Newton pers. comm.).

The collections of *Aloe maculata* that were available to C. Commelijn are attributed to H.B. Oldenland (\pm 1663–early 1697). *A. maculata* was cultivated in the Dutch East India Company's Garden at the Cape in 1695, when Oldenland was Superintendent and a species with the name *Aloe Africana caulescens foliis spinosis maculis ab utraque parte albicantibus notatis* was listed in his herbarium. Oldenland's name was later used by C. Commelijn in the plate that first depicted this species. It is not known where Oldenland collected the first specimens of *A. maculata* as the species is widely distributed, from the

Cape Peninsula to Swaziland (Reynolds 1950; Van Wyk & Smith 2003), but more than likely it would have been in or near Cape Town since this is a known locality for the species.

The plate that depicts the plant, here designated as lectotype, had already been referred to in the literature as the iconotype of this species (Glen & Hardy 2000). However, the term iconotype has no status in the typification process as formalized in the ICBN (McNeill *et al.* 2006). The plant depicted in the plate lacks an inflorescence and consequently it lacks some of the critical characters needed to easily distinguish it from other spotted-leaved aloes. For this reason, an epitype is designated here.

Diagnostic morphological characters: maculate (spotted) aloe with flat-topped, capitate (head-shaped) racemes of about 0.6 m tall and uniformly coloured flowers.

Geographical distribution: *Aloe maculata* has one of the widest known distribution ranges of all the aloes. It occurs commonly from the Cape Peninsula along the climatically moderate southern African coastal belt below the Great Escarpment to as far north and northeast as KwaZulu-Natal, Mpumalanga, Limpopo and Swaziland, but apparently does not enter neighbouring Mozambique. It also occurs in the southern African interior in Lesotho and in South Africa's Free State Province, both of which have a harsh, continental climate (Figure 2).

Aloe succotrina All., Auctarium ad synopsis methodica stirpium horti regii taurinensis 5: 65 (1773). *Locus classicus:* Sobolem hujus plantae, ex India orientali in Hollandiam transmissae ... [= *A. succotrina* Weston, *Botanicus universalis et hortulanus ... Tabulis aeneis illustratis tomis quatuor ...* Londini (prostant venales apud J. Bell), vol. I, 5 (1770). Lectotype: J. Commelijn, *Horti medici Amstelodamensis*, 1: fig. 48 (1697) (Wijnands 1983: 126) (Figure 3). Epitype, here designated: boulder field near Window Gorge, above Newlands, 500 m alt., July 1905, Marloth 3967 (PRE)].

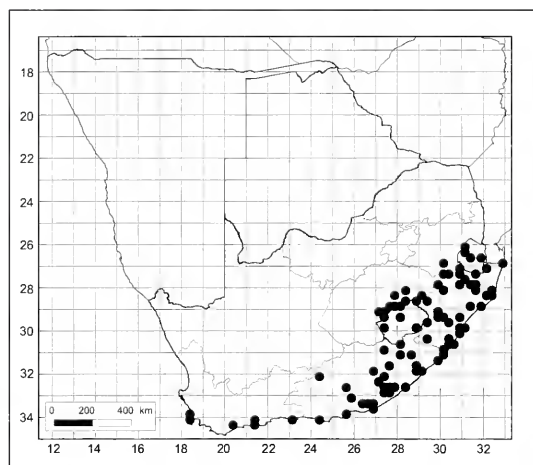


FIGURE 2.—Geographical distribution of *Aloe maculata* All. based on specimens held in the National Herbarium (PRE), KwaZulu-Natal Herbarium (NH), Compton Herbarium (NBG) and the South African Museum Collection (SAM) held in NBG.

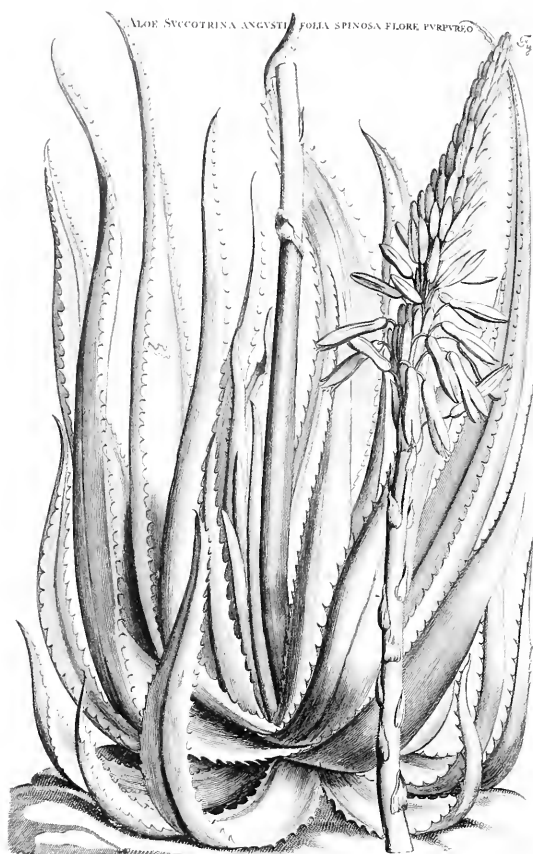


FIGURE 3.—*Aloe succotrina angustifolia spinosa flore purpureo* (= lectotype of *Aloe succotrina* Weston). In J. Commelijn, *Horti medici Amstelodamensis. Pars prima*. Blaeu, Amstelodami, 1697, fig. 48.

Taxonomic and nomenclatural notes: the name *Aloe succotrina* is still commonly attributed to Lamarck in the International Plant Name Index (IPNI) 2008; TROPICOS 2008; African Plant Checklist and Database (APCD) 2008; or to Allioni (Dandy 1970), but the first valid publication of the name was by Weston (1770). Apart from the short description, Weston gave no other indication (distribution, materials, etc.) for his *succotrina*, but in the introduction to his publication he referred to Linnaeus (1764). For the description of *Aloe succotrina*, Weston copied Linnaeus *verbatim* [the name was not validly published by Linnaeus, who simply copied J. Commelijn's (1697) polynomial, sinking it into the synonymy of *A. perfoliata*]. That *A. succotrina* Weston was based on J. Commelijn's plate was also reported by Brown (1911). We therefore designate the plate published in *Horti medici Amstelodamensis* (J. Commelijn 1697: fig 48) as the lectotype of *A. succotrina* Weston. Since Allioni (1773) also referred to the same J. Commelijn figure, his *A. succotrina* is a later homonym of the name of Weston.

The origin of the name and its misapplication to other, non-South African species, has been discussed in the literature (see Reynolds 1950). *Aloe succotrina* does not occur on the island of Socotra and it is suggested that the epithet derives from 'succocitrina', referring to the yellow

low colour of the sap crystals when pounded (Reynolds 1950), although the purple colour of the dried leaves is one of the distinctive characters of the species (Glen & Hardy 2000; Van Wyk & Smith 2003).

Given that the purple colour of the dry leaves of *Aloe succotrina* is an important diagnostic character for the species, it could be argued that the illustration (plate) alone is insufficient to allow for the positive identification of the species. It is thought that *A. succotrina* may have been collected for the first time near Kloof Nek (Reynolds 1950; Smith & Van Wyk 1996). Brown (1911: 142) states that 'Although *Aloe succotrina* is not mentioned by Thunberg in his *Prodromus* or *Flora*, yet in his *Travels*, English translation, edn 3, vol 1: 213, he mentions, under the date of 14th December 1772, when at a farm near Slange River, in the Oudtshoorn Division, that "Here we saw quickset hedges of *Aloe succotrina*"'. This locality is quite remote from Kloof Nek, which is in Cape Town. According to Brown (1911), Thunberg probably referred to *A. fruticosa*, which is now regarded as a synonym of *Aloe arborescens* Mill. Even though *A. succotrina* had therefore been known for more than 200 years, this species was only accurately recorded for the first time in the wild in 1906 by Rudolf Marloth. It was then stated to occur in a field of boulders above Newlands, presumably in or near what is today the Kirstenbosch National Botanical Garden, and also near Hout Bay along the coast near Cape Town. A voucher specimen for the occurrence of the species at the former locality (Marloth 3967) is therefore here designated as the epitype.

Diagnostic characters: shrubby aloe with tall, erect, unbranched inflorescences and greyish green leaves that, once dry, are persistent and purple, and with white, deltoid teeth on the margins.

Geographical distribution: the species is restricted to the southwestern Cape of South Africa. It typically occurs in fynbos vegetation on and against sandstone rocks and cliffs from the Cape Peninsula eastwards to Hermanus (Figure 4).

Aloe verrucosospinosa All.: 65 (1773). Lectotype, here designated: C. Commelijn, *Praeludia botanica*: fig. 26 (1703) (Figure 5) [= *A. humilis* (L.) Mill., The abridgement of the Gardener's dictionary: no. 10 (1771). Lectotype: C. Commelijn, *Horti medici Amstelodamensis plantae rariores et exoticae ad vivum aeri incisae*: fig. 46 (1706) (Wjinands 1983: 124) (Figure 6). Epitype, here designated: Mossel Bay, C.P., 28 July 1915, *Pole Evans* 194 (PRE)].

Taxonomic and nomenclatural notes: the original spelling was *Aloe verrucosospinosa*. Following article 60.1 of the ICBN (McNeill *et al.* 2006) the orthographically correct name is *A. verrucosospinosa*. No original material of this species was found in Allioni's herbarium.

Wjinands (1983: 124) used plate 46 in C. Commelijn (1706) as the lectotype of *Aloe humilis* and *A. verrucosospinosa*. However, Allioni referred to page 77 in C. Commelijn (1703) to which plate 26 is attached; although plate 46 (C. Commelijn 1706) apparently refers to the same plant, it is not simply a reproduction, since it differs in several details and includes an inflorescence which is

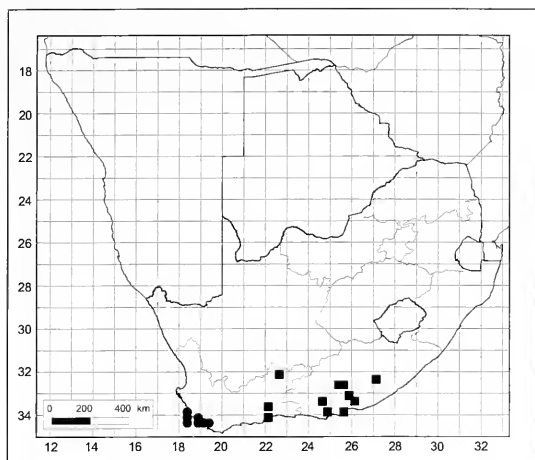


FIGURE 4.—Geographical distribution of *Aloe succotrina* Weston, ●, and *A. verrucosospinosa* All. (= *Aloe humilis* Mill.), ■, based on specimens held in the National Herbarium (PRE), KwaZulu-Natal Herbarium (NH), Compton Herbarium (NBG) and the South African Museum Collection (SAM) held in NBG.

missing from plate 26. Thus, plate 46 in C. Commelijn (1706) cannot be considered as original material of *A. verrucosospinosa* in the sense of Art. 9.2 of the ICBN and consequently it cannot be used as its lectotype. We designate here, as lectotype of *Aloe verrucosospinosa* All., plate 26 in *Praeludia botanica* (C. Commelijn 1703).

Although the vegetative characters shown in the plate 26 are consistent with the concept of *A. humilis*, and the same specimen was apparently later depicted with an inflorescence, it may be confused with other species which occur in, or approximate to, its distribution area, especially since two look-alike miniatures (*A. aristata* Haw. and *A. brevifolia* Mill.) also have leaf tubercles and marginal teeth. For this reason, an epitype is designated here. It is possible that the first collections of *Aloe humilis* were made near Oudtshoorn, the westernmost locality of the species on the route taken by Oldenland (Reynolds 1950). A collection made by Pole Evans in 1915 under the number 194 (PRE), at Mossel Bay, a locality ± 80 km from Oudtshoorn which is the westernmost occurrence of the species along the coast, is here designated as epitype. It was cited by Reynolds (1950) under *A. humilis*.

As was the case with *Aloe maculata*, the material of '*Aloe Afric. humilis spin. et verrucis obsita*' that was available to Commelijn, and was later used for the descriptions of *A. humilis* and *A. verrucosospinosa*, is attributable to Oldenland. Oldenland accompanied the Schrijver expedition towards the eastern interior of the Eastern Cape in 1689. The expedition reached the vicinities of Oudtshoorn and Uniondale, travelling into the arid interior as far east as 30 km northwest of Aberdeen. *Aloe humilis* was one of the species that was planted in the Dutch East India Company's Garden at the Cape, and was growing there in 1695 when Oldenland was Superintendent. The name '*Aloe Africana humilis spinis inermibus et verrucis obsita*' was already given by Oldenland and later used by Commelijn (Reynolds 1950).

ALOE AFRIC. HUMILIS SPIN ET VERRUCIS OBSITA Fig. 26

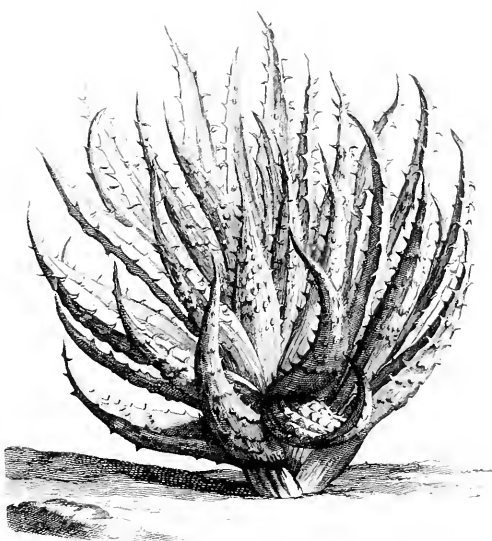


FIGURE 5.—*Aloe Afric. humilis spin. et verrucis obsita* (= lectotype of *Aloe verrucosospinosa* All.). In C. Commelijn, *Praeludia Botanica*. Haringh, Leiden, 1703, fig. 26.

Allioni's binomial is not cited by Newton (2001a, b) nor is it listed in TROPICOS 2008, the IPNI 2008 or World Checklist of Selected Plant Families (WCSP) 2008. However, Dandy (1970), Wijnands (1983: 124), APCD 2008 and Plants of southern Africa (POSA) 2008 cited *A. verrucosospinosa* [sic] as a later synonym of *A. humilis* (L.) Mill., an interpretation with which we agree.

Diagnostic characters: miniature aloe with leaves carrying soft, harmless tubercles and teeth, and short, stout inflorescences with large, loosely packed, pencil-shaped flowers.

Geographical distribution: the species has a wide distribution range in the southern and eastern Cape of South Africa, where it occurs in the arid interior in sparse shrublands in the Little and Great Karoo, as well as on coastal hills in renosterveld or in dry, subtropical thicket, from Mossel Bay in the west to Grahamstown in the east (Figure 4).

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ALOE AFRIC. HUMILIS SPIN. ET VERRUCIS OBSITA. Fig. 46

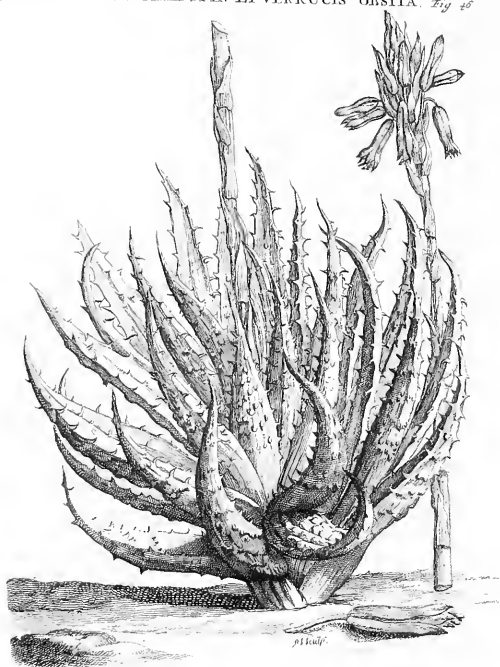


FIGURE 6.—*Aloe Afric. humilis spin. et verrucis obsita* [= lectotype of *Aloe humilis* (L.) Mill.]. In C. Commelijn, *Horti medici Amstelodamensis plantae rariores et exoticae*. Haringh, Leiden, 1706, fig. 46.

houses the South African Museum Collection (SAM), and the KwaZulu-Natal Herbarium (NH) are thanked for providing information on the distribution ranges of *Aloe humilis*, *A. maculata* and *A. succotrina*.

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The botany of the Cunene–Zambezi Expedition with notes on Hugo Baum (1867–1950)

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ABSTRACT

A record and discussion of the Cunene–Zambezi Expedition that took place in Angola from 1899 to 1900 is provided. Although the main aim of the expedition was to evaluate the economic potential of southern Angola, it also resulted in significant botanical collections made by Hugo Baum (1867–1950), many of which serve as holotypes of names of plants from the region, and beyond. The itinerary is supplemented by a map illustrating the route followed by the expedition, and locality names are clarified and updated. A full list of the type specimens of flowering plants is provided, with their nomenclature updated and an indication of where known duplicates are housed.

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INTRODUCTION

The collector Hugo Baum (1867–1950) participated in the Cunene–Zambezi Expedition, which took place in Angola from 1899 to 1900, led by the Dutchman, Pieter van der Kellen. In addition to botanical and zoological collections, ethnological observations were also recorded. All of these were described in German by Warburg (1903) in the now very rare book *Kunene–Sambesi Expedition. H. Baum*, which can only be found in highly specialized libraries or in the collections of rare book antiquarians. The book includes a folded map (Figure 1) that illustrates the course of the expedition, which left Moçâmedes (Namibe) on 11 August 1899 in an easterly direction, through the actual provinces of Cunene and Cuando-Cubango, reaching

the Cuando River in March 1900. After turning around, the expedition finally arrived back at Moçâmedes on 26 June 1900, more than 10 months later.

The expedition resulted in over 1 000 plant collections, many of which are types. In Warburg (1903), 281 taxa of flowering plants new to science are described based on these collections, with 310 numbers referred to as types. To these must be added an unknown number of taxa that were published later. In the Aluka database of types of African plant names (Aluka 2008, accessed in January 2008), there are 1 209 images of specimens collected by Baum. This figure includes duplicates of the same collection number. In fact, the Baum collections provided a series of duplicates distributed among European herbaria. This is fortunate because the holotypes of the taxa published in Warburg (1903) were deposited in the Herbarium of Berlin (B) and many of these specimens were destroyed in a fire during the Second World War. For that reason the Aluka database presently hosts only 48 images of Baum specimens from B. Duplicates have been recorded in various herbaria, namely B, BM, BR, COI, E, G, K, M, NY, P, S, W and Z (Holmgren, *et al.* 1990), which include several herbaria that were not listed as depositories of Baum collections in Lanjouw & Stafleu (1954). However, for some taxa, the holotype destroyed at B was apparently unique.

In terms of type material the Baum collection is one of the most important among those that originated in Angola, and is only surpassed by those of F. Welwitsch and J. Gossweiler. In addition to their type status, they provide information on type locality. This is very important in the case of rare plants, particularly those that were collected only once. Information on the exact collecting localities helps researchers find rare plants in the field, which in turn facilitates the eventual proposal of specific conservation measures. In the case of the Baum collection, pinpointing the collecting localities is often difficult for several reasons: 1, localities recorded on the labels are often not consistent with duplicates of the same collection, or localities given in the book; 2, the changes of geographical place names that took place in Angola over the last century; and 3, the original spelling of the localities that does not match the more recent spelling used in maps and gazetteers.

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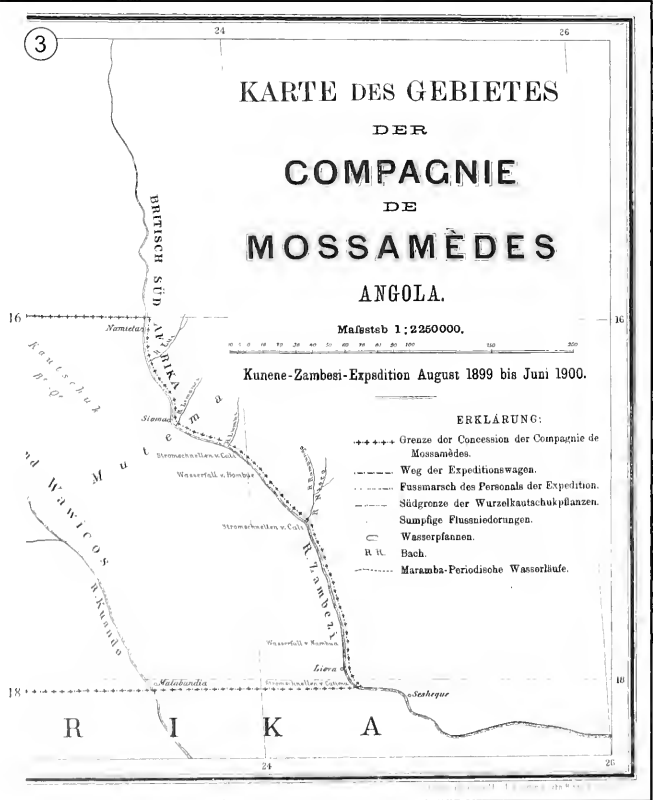
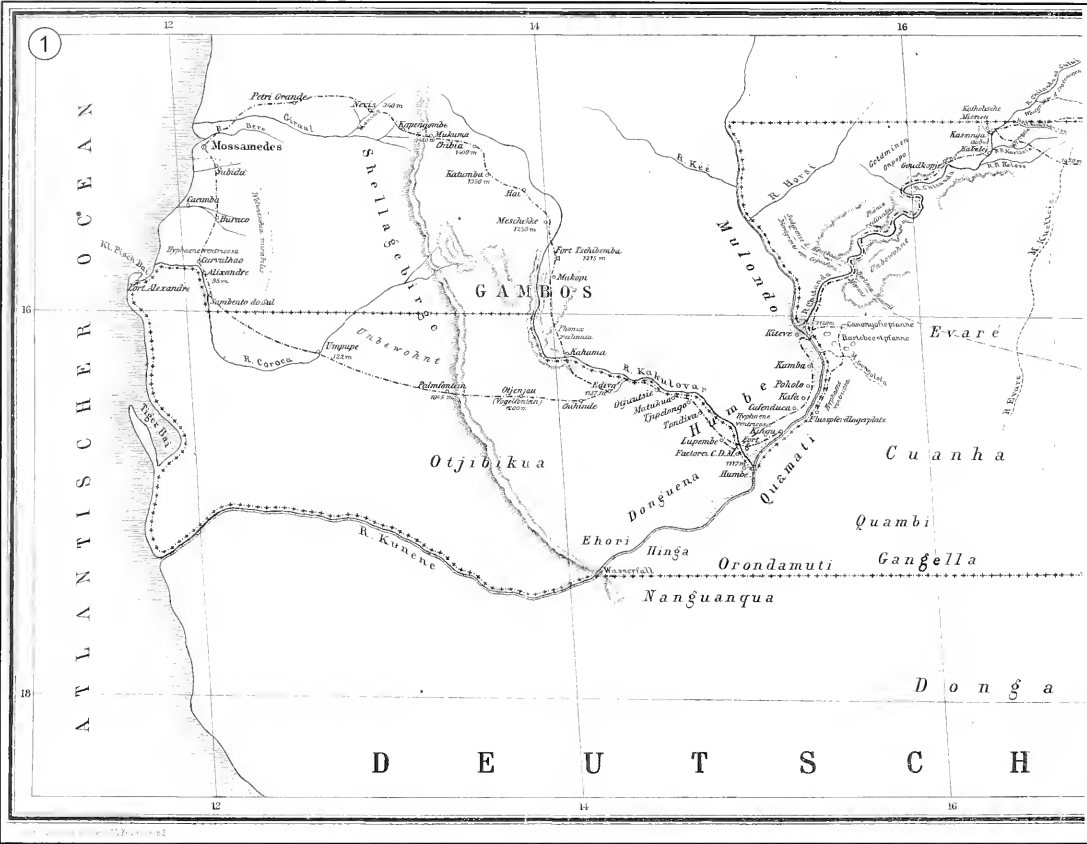
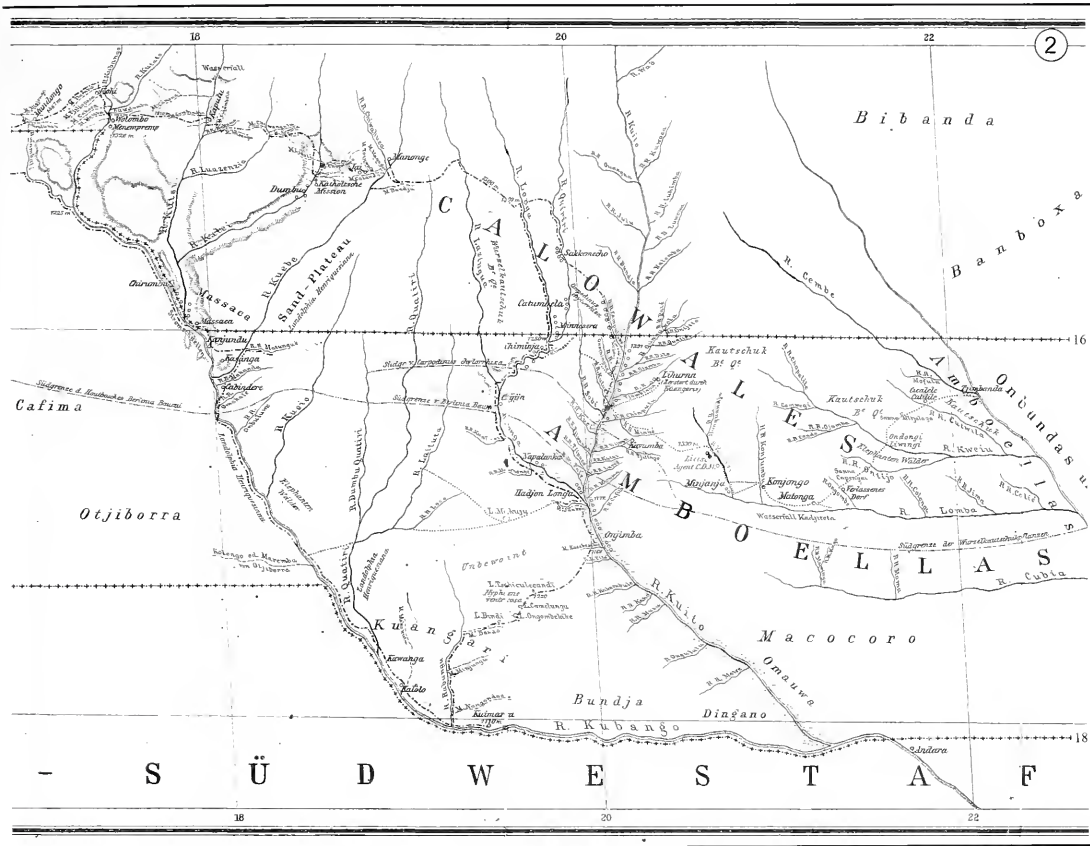


FIGURE 1.—Original map of expedition itinerary divided into three sections (Warburg 1903).



To facilitate the work of taxonomists and systematists studying the flora of southern Africa, the Baum collections and expedition itinerary were analysed. In the present work we include an historical overview of the expedition and an analysis of the flowering plant type material cited in the book (Warburg 1903). Based on the original map, a new map has been produced, which is complemented by a list of old locality names, as cited in Warburg (1903), and the corresponding current names and, whenever possible, geographical co-ordinates.

MATERIAL AND METHODS

The information on type collections was obtained from several sources. Initially, the information on types cited in Warburg (1903) was databased, using Figueiredo & Smith (2008) to update the nomenclature. The location of duplicates was determined mostly using internet resources. In this regard, the Aluka database (www.aluka.org) was particularly useful. Several herbaria online, such as K (www.kew.org/herbat), B (www.bgbm.org) and Z (<http://www.zuerich-herbarien.unizh.ch/>) also provided much information. Duplicates cited in the literature but not seen (either in herbaria or as images) were included in the database. Information from COI was obtained from a card catalogue. The existence of B types was verified using the resources mentioned above and a list of families including extant collections at B (Hiepko 1987). It was noted that the localities recorded on the labels are often not consistent with duplicates of the same collec-

tion. Furthermore, they often do not match exactly the localities given in the book. As a compromise the collecting localities given in Warburg (1903) are used.

The types are listed in alphabetical order by family, genus and species, in their currently accepted taxonomy (Figueiredo & Smith 2008). An index to all the scientific names as well as a sequential index of type numbers referring to their name in this list, is also presented.

A list of several geographical names, cited in Warburg (1903) as collecting localities, as well as those shown on the map, was compiled. The location of the names was determined using maps and gazetteers. An annotated copy of the Warburg (1903) map, produced at LISC, was examined. A new map (Figure 2) showing the itinerary and updated locality names was produced based on the information compiled.

HISTORICAL OVERVIEW AND ITINERARY OF THE EXPEDITION

Hugo Baum was born on 17 January 1867 in Forst Niederlehmsitz, the son of a railwayman. He was raised in Guben on the river Neisse (then in Brandenburg, Germany; now Polish and called Gubin) in a forested area where he developed an interest in plants and insects. After concluding his school education in Guben, he started his professional training as a gardener in Nettkow (Silesia; then German now Polish) and later attended a

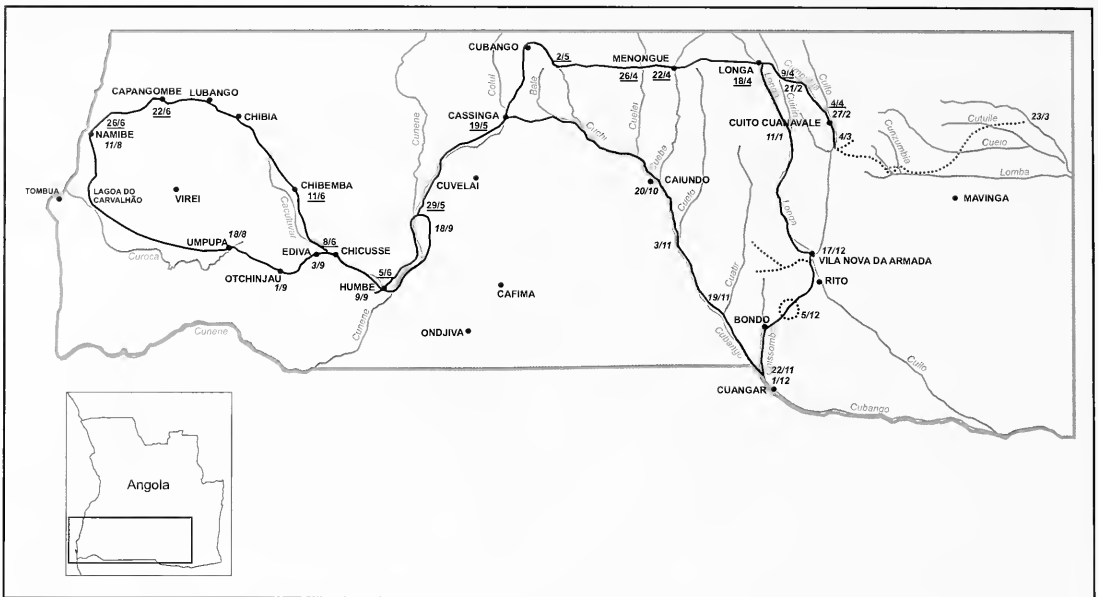


FIGURE 2.—Actual map of expedition itinerary showing route taken by ox-wagons (continuous line), routes travelled on foot (dotted lines), and dates when some localities were reached (in italics for journey out, underlined for return journey).

two-year study course in pomology in Proskau (Silesia). Following his compulsory military service in Magdeburg, he worked for ten years at the old Botanical Garden in Berlin. In 1899, thanks to his extensive botanical knowledge, he was invited to participate in the Cunene-Zambezi Expedition. After his return from Angola, in 1901, Baum was employed as master gardener by the Botanical Garden of the University of Rostock. In the same year he married Auguste Tank. For the following few years Baum busied himself evaluating the Cunene-Zambezi Expedition and in 1903 the expedition report was published. Baum undertook another botanical expedition to Mexico, from January to May 1925. In 1926 he was promoted to chief garden inspector (Gartenoberinspector) of the University of Rostock, and in 1933, at the age of 66, he retired. On 15 April 1950, shortly after his 83rd birthday, Baum died impoverished. His wife passed away the following year. Altogether 71 taxa, including two genera, namely *Bauniella* (a mushroom) and *Baumia* (belonging to the Scrophulariaceae), have been named after Baum (Mansfeld 1983; Heintze 2007).

The Cunene-Zambezi Expedition was carried out at the request of the Berlin-based Colonial-Economic Committee together with the Compagnie de Moçâmedes (Paris) and the South West Africa Company (London). Its objective was to investigate the economic potential of the south of Angola. The expedition was the result of the interest of German Southwest Africa (now Namibia) in the planned train connection between Porto Alexandre (presently Tombua) in Angola and the then independent Zuid-Afrikaanse Republiek, later the Transvaal province of South Africa. At the time, there was a lack of knowledge of wild-growing cash crops and local African cultures in the area. In his expedition report Hugo Baum did not only describe the flora, but also provided information on the geography, geology, climate, the local people encountered on the expedition, and some of their cus-

toms. The leader of the expedition was the Dutchman, Pieter van der Kellen, who was the representative of the Compagnie de Moçâmedes in Ediva.

On 11 August 1899, the expedition left Moçâmedes (presently Namibe) with three ox-wagons for the rivers Kunene, Kubango, Kuito, up to the Cuando, and on 26 June 1900 it returned to the place from which it departed (Figures 1, 2; refer to Appendix 1 for actual name and co-ordinates of localities, which are mentioned in this text with the original spelling). At the time Moçâmedes was a town of 1 500 inhabitants with a local economy dominated by the trade in dried fish.

The most common acacia species found between Ediva and Humbe was *Acacia verrucifera* Harms [= *Acacia kirkii* Oliv. subsp. *kirkii* var. *kirkii*] that provided the best transparent gum (*gummi arabica*) of great bonding strength. The distribution area of this acacia extended from the Chela Mountains to the Kunene River, and from the Chitanda and the Kubango Rivers downwards to the territory of the Kuangari tribe. Near Chihinde, Baum collected *Strophanthus amboensis* (Schinz) Engl. & Pax of which only a few plants were found. At the same location he found for the first time a plant that was referred to as *Gardenia thunbergia* Thunb. [of which the collected specimen is *Gardenia volkensii* K.Schum. subsp. *spatulifolia* (Stapf & Hutch.) Verdc.], which was called *stumpdorn*, the German version of the Afrikaans *stompdoring*, a name recorded by Smith (1966), and *mulavi* by the local Africans. This tree appeared frequently along the Kunene, Chitanda and Kubango Rivers, but also along the Longa and Kuito Rivers and grew predominantly in the low grounds of the rivers or on the river islands.

The expedition arrived at Ediva on 3 September and there they met the leader Van der Kellen and two Boers

and two Africans with horses, who had been hired by the Dutchman at Humpata as hunters to provide game meat for the expedition. Van der Kellen's brother Emil managed a large farm in Ediva. It was owned by the Compagnie de Moçâmedes, and cultivated various food and cash crops, and carried between 800 and 1 000 head of cattle.

After Ediva, the first place reached by the expedition on their way to Humbe was called Otjikutsie. Humbe used to have a trading post for cattle. However, it had lost importance since the outbreak of the cattle plague. The local population in Humbe cultivated sorghum, pennisetum, groundnuts, groundpeas and to a lesser extent beans, locally called *macundi*. From Humbe the expedition travelled on the same day to the Kunene River. On 12 September they crossed the Kunene with the support of the people of Humbe, of whom some 40 men had joined the expedition as porters. On the left bank of the Kunene the expedition headed upstream to the mouth of the Chitanda River.

At the Chitanda, the *houtbosch*, *Berlinia baumii* Harms [= *Julbernardia paniculata* (Benth.) Troupin], which they considered the most common tree in southern Angola, was noticed for the first time. The local population used the bark of this tree for the production of boats. In Goudkopje, on the banks of the Chitanda, a place also locally called Ompopo, the expedition spent several days searching for alluvial gold in the river; they did find a small quantity. In early October the expedition reached Kassinga, also on the banks of the Chitanda. From there, they went on to the Nambali stream which flows into the Kubango River.

On 8 October the explorers reached the Kubango at Linghonung, the first village they came across since Kassinga. Following the Kubango, on 15 October the expedition came to the village of Chirumbo, located on a river island to protect the population against assaults by the Kuinghama tribe (Kwanhama?) from Ovamboland. On 16 October they crossed the Kubango for the first time between the Kutsi River and Massaca, a fortified village inhabited by some 500 people. From Massaca the explorers travelled the Kubango downstream to a village called Kanjundu, where they left the Kubango to proceed to the Kuebe River, which they followed downstream to its confluence with the Kubango. Then they continued along the Kubango to the mouth of the Quatiri River. Downstream from the mouth of the Quatiri, the expedition passed through the village of Kavanga on the Kubango that was inhabited by the Kangella tribe. From there, the explorers followed the Kubango downstream along the border with German Southwest Africa (presently Namibia) to Imbala, the principal village of the Kuangaris. On 27 November, the expedition left Imbala accompanied by a dozen Kuangari guides following the Kubango upstream to the confluence with the Habungu and then along this stream further upstream.

From the Habungu the journey continued to the Bondo, a small stream that contained little water even during the rainy season, which they followed for only a small distance. From there the expedition went to the lake-like pan called Ungombekike from where some of the Kuangari guides returned home. After passing through two other pans the group reached the Kuito River. Moving upstream along the Kuito, after a few days the group reached the mouth of the stream Jonkoa and from there,

the nearby mouth of the Longa. On 26 December, the explorers arrived at the village Napalanka, situated in a valley between the Longa and inaccessible swamps. After following the Longa upstream for four days, the expedition arrived at a place called Minnesera, which is situated in the swampy area of the mouth of the Quiriri.

On 16 January 1900, the group crossed the Longa, of which the banks were so swampy that 80 oxen were needed to pull the wagons out of the swamp. Downstream from the mouth of the Quiriri the expedition erected a camp where they were visited by the chief of Minnesera and 30 of his people. A few kilometres downstream from Minnesera, the Longa was crossed again with a float. On 31 January the expedition reached the same location at the Longa where they had been on the 12th. Due to a lack of food supplies for the expedition, following the local population's refusal to barter for food supplies, sweet potatoes were simply taken in sacks from nearby fields to feed the carriers and the horses. The shortage of maize rations had weakened the horses, which forced the expedition to reduce the hunting parties, which, in turn, resulted in a lack of game meat.

Subsequently the expedition reached a ford at the Longa, which rubber dealers used as passage-way. At that place, several residing dealers exchanged root rubber, *Carpodinus chylorrhiza* K.Schum. [= *Landolphia thollonii* Dewèvre] for commodities. Two-wheeled carriages were also sent to collect the rubber in the surrounding region. The dealers kept considerable rubber stocks tied up in bundles of 40 finger-strong rubber strips (see below), which as an exchange unit were called *manga*. The weight of one *manga* was about one kilogram. The expedition managed to purchase eleven sacks of maize from a local Portuguese man. That became their only foodstuff and had to be rationed. Due to the food shortage, 17 of the porters were sent back to Humbe and Ediva.

One of the ox-wagons left the Longa for the Quiriri, while the two others remained at the Longa to trade. The expedition avoided contact with the Portuguese traders at the Quiriri, because '...the Portuguese in the colonies were often deported persons...' (Warburg 1903: 93). However, they associated with the Swedish trader Swanström who sent them freshly baked bread. Later the two ox-wagons that were left at the Longa rejoined the expedition at the Quiriri, where in a few days, 300 *mangas* would be exchanged for cotton cloth. From the Quiriri downstream the inhabitants of the many villages were busy with the preparation of rubber. In a village at the Quiriri called Sakkemecho, the expedition exchanged consumer goods and cattle for 297 *mangas* on credit that would be collected after a few months during the return journey.

In the rubber-producing area, rubber completely replaced money as local currency. Root rubber was predominantly found on large grass fields on sandy soils, called *chanas* (*sannas*), which were surrounded by forests. The plant did not grow near the streams and rivers, but on the waterless *chanas* between the streams. Formerly, the root rubber plant had occurred commonly at the Kutsi and the Kubango Rivers at Massaca, where it had now become completely extinct. However, the plant was said to exist in the territory of the Kuinghama tribe and occurred above the mouth of the Luassingua, reach-

ing the Longa, Quiriri, Kampuluve and Kuito Rivers. Its range went beyond the latter and extended even as far as the Cuando. After having been dug out with short hoes, the roots, tied up into stacks of ± 2 m tall, were watered regularly to soften the bark so that it later peeled off easily. Thereafter, the bales were again dried in the sun and the single roots were cut into 30 to 40 cm long pieces that were beaten on a board to remove the bark from the wood. The pieces of bark were then worked with a wooden hammer until they took the form of a cake. This cake was boiled and again beaten with clubs. Finally the cake was cut into square pieces, which were placed in boiling water and, while still hot, were shaped into cylindrical, finger- to thumb-thick strips, about the length of a span of the hand (± 22 cm) called *matali*, of which 40 pieces constituted one *manga*. There were a total of eleven traders in the entire rubber area, of whom nine were Portuguese, one was an Englishman and one a Swede.

The expedition continued the journey from Sakke-mecho, crossing a waterless and hilly area between the Quiriri stream and the Kampuluve, which ran into the Kuito River. The expedition reached the Kampuluve at its source in a swampy valley that extended for 25 to 30 km up to the mouth of the stream. They arrived there on 27 February 1900 and reached the Kuito River for the second time. At that point the Kuito was at most 150 m wide, but with very deep and fast-flowing water. On 14 March, the expedition crossed the Kuito with canoes and on the same day reached a stream called Chinpulu on foot. Due to the lack of grass for the oxen at the Kuito the wagons and oxen had been sent back with two people to the Onschingue River where the others were expected to arrive at the end of March. From the Chinpulu River the men reached a small stream called Miané that they followed up to its source. Then the march continued through waterless hills to the Kuisi stream in the Zambezi area. The expedition followed the Kuisi downstream, then crossed it and after several hours reached the village Konjongo at the Konjumbu, a small stream.

By the time the expedition reached Konjongo, Baum was weakened by fever and stomach pains and he decided to return with two porters to the Kuito River, which they crossed to the right bank. From there the group went to the Onschingue where on 1 April they met part of the expedition that had remained at the Cuando. On 4 April, the expedition initiated the return journey along the previous route, upstream along the Kuito and Kampuluve Rivers up to the Sakkemecho village, where they delivered to the local inhabitants part of the rubber they owed them from the previous transaction.

From the Sakkemecho village, the men followed the Quiriri upstream and then crossed the sandy hills to the Longa. From the Longa the expedition travelled to the Lazingua, and then westwards passing the Quatiri to the Bundju stream, where they remained for some time to allow the oxen some rest. The journey continued to the Kuebe and the Kulei, a tributary of the Kutsi. The passage across the Kutsi, which was rather deep, took three days. From there the journey went on to the Kubango. The crossing of the Kubango with more than a hundred head of cattle and the wagons that had to be dissembled to be ferried across the river, took another five days. The

group then followed the Cubango upstream and turned westward behind Kohi.

On 19 May, the expedition arrived at the Chitanga River and shortly afterwards at nearby Kassinga. After a half-day stay in Kassinga, the expedition followed the Chitanga downstream to Goudkopje. The Chitanga area was rich in game. On 29 May the expedition reached the Kunene at Kiteve. The local population provided eight large boats to help the expedition cross the Kunene within two days. From Kiteve the expedition followed the Kunene downstream. On 5 June the men arrived at Humbe where the porters from that place left the expedition after having been paid for their services. For the remaining journey to the coast the expedition recruited other local porters. On their way to Ediva at the Kaculovar River that was reached after two and a half days, they met the Dutchman Emil van der Kellen who had come by horse from Ediva when he had heard about the expedition's return.

At a place called Kahama, the expedition crossed the Kaculovar a second time and then followed it upstream. In the clay soils along the Kaculovar, Baum again frequently found *Acacia kirkii* Oliv., which was said to produce the best gum. Within two days the expedition crossed the passage through the Chela Mountains. After leaving the mountains, the men went along a stream called Tschikutt passing consecutively through Pietfontein [Pietfontein in modern Afrikaans], the dry Olefantsrivier [Olifantsrivier], the Bumbo and the Kitibe. At Monino village they had a longer rest before they walked the long and dry way to the Giraul River. From there the expedition travelled the last part to Moçamedes, where they arrived on 26 June 1900.

During the ten-month journey, members of the expedition killed 175 antelopes, 3 hippos, 2 boars, and 3 crocodiles. Baum collected a total of 1 016 plant collection numbers, of which more than 300 were later described as new taxa. More than 60 of the new species were named after Baum. Besides this haul, Baum caught more than 300 butterflies, prepared them and sent them to Europe.

With regard to the economic importance of southern Angola, Baum recommended the areas close to the coast at the small rivers Bero, Giraul, Monino, and Coroca for the establishment of plantations, particularly for the cultivation of cotton. In his opinion, the high plateau, predominantly constituted of heavy loamy or clay soils was suitable for the cultivation of maize, wheat, rye, oats, barley, and European vegetables, subtropical fruits such as citrus, and grapevines. According to Baum, there was much fertile land for colonization at the Cuando. The part of this area east of the Cuebe and north of the Lomba was characterized by a wealth of root rubber plants. He considered the region particularly rich in trees providing tanning agents, such as the *mopane*, *Colophospermum mopane* (J.Kirk ex Benth.) J.Léonard, and the *houtbosch*, *Julbernardia paniculata* (Benth.) Troupin. The distribution area of the acacia that provided the best gum was located in the region of the Caculovar and Kunene. Thanks to its large forests, southern Angola was considered very rich in timber; however, the cost of transport to the coast was very high. Although gold was panned in the Chitanda River at Goudkopje beneath

Cassinga, the main value of southern Angola was that it was very suitable for livestock. In Baum's opinion the transport of cattle to the coast was easy, given the availability of water and pastures along the whole way. Finally, he emphasized the abundance of fish resources at Moçâmedes (Namibe), Tiger Bay, and particularly Porto Alexandre (Tombua), where salterns that produced salt for the preservation of fish were located.

LIST OF BAUM TYPE COLLECTIONS GIVEN IN WARBURG (1903)

All the holotypes (or syntypes) of the names published in Warburg (1903) were deposited at B. Information is available in the literature and on the internet concerning the families which survived the fire that consumed the herbarium during the Second World War (see www.bgbm.org). At the time of the bombardment, the staff of the herbarium was undertaking the task of transferring the type specimens to a safer location. Types belonging to certain families are therefore still extant at Berlin. Likewise, material on loan to other herbaria obviously also survived. The remaining material has been reported as lost. In the case of the Baum collections, out of the 311 type collection numbers of flowering plants cited in Warburg (1903), only 40 holotypes and four syntypes are confirmed to exist. There are 181 holotypes reported as destroyed, and 34 belonging to families for which type material apparently survived, could not be located in any of the databases cited above. In rare cases, types that were reported as destroyed in the literature were found to be extant as they are available in the Aluka database. This is the case for the holotype of *Lobelia minutidentata* Engl. & Gilg, that had been reported as destroyed (Thulin 1984). This was probably due to the misplacement of the specimen as the locality data provided to Aluka wrongly assigns it to Namibia. It was noticed that several Baum collections have been attributed to the wrong country, and depending on the arrangement of herbaria, this may be a reason for the material not having been found in the past. For instance, *Baum 894* (*Cephalaria retroseta* Engl. & Gilg), is represented in Aluka (accessed in February 2008) by three duplicates: the K duplicate is attributed to South Africa, the BM duplicate to the Democratic Republic of Congo and only the duplicate in E is correctly assigned to Angola. In other cases it was found that types belonging to families that were reported as destroyed still exist. For example, in the Rubiaceae, at least four Baum types are extant.

Note: duplicate specimens in bold were accessible in Aluka (accessed in February 2008); duplicate specimens not in bold were accessible in other databases or examined by one of the authors; the * sign is used for duplicates listed in the literature but not in databases. The original spelling of the localities is kept.

ACANTHACEAE

DUOSPERMA Dayton

quadrangulare (Klotzsch) Brummitt

32 Type of *Hygrophila affinis* Lindau (B. holo. ♀?; COI, G, K, W, iso.). Palmfontein, 28-8-1899, 1 000 m.

sessilifolium (Lindau) Brummitt

942 Type of *Hygrophila sessilifolia* Lindau (B. holo. ♀?; BR, COI, G, K, W, Z, iso.). Chitanda (left bank), 25-5-1900, 1 150 m.

LEPIDAGATHIS Willd.

macrochila Lindau

779 (B. holo. ♀?; COI, K, M, W, iso.). Kusisi, Likise, 16-3-1900, 1 225 m.

STROBILANTHOPSIS S.Moore

linifolia (T.Anderson ex C.B.Clarke) Milne-Redh.

830 Type of *Hygrophila glutinifolia* Lindau (B. holo. ♀?; COI, G, K, M, W, iso.). Longa-Lazingua, 18-4-1900, 1 350 m.

ALLIACEAE

TULBAGHIA L.

aequinoctialis Welw. ex Baker subsp. **monantha** (Engl. & Gilg) R.B.Burb.

351a Type of *Tulbaghia monantha* Engl. & Gilg (B. holo.). Kubango. Kabindere, 30-10-1899.

AMARYLLIDACEAE

AMMOCHARIS Herb.

baumii (Harms) Milne-Redh. & Schweick.

273 Type of *Crinum baumii* Harms (B. holo.; BR, COI, G, M, S, Z, iso.). Kubango, Chirumbu, 14-10-1899, 1 200 m.

ANACARDIACEAE

OZOROA Delile

argyrochrysea (Engl. & Gilg) R.Fern. & A.Fern.

892 Type of *Heeria benguelensis* Engl. var. *petrophila* Engl. & Gilg (B. holo. ♀; *BM, BR, *COI, *K, M, W, Z, iso.). Kutsi, Kapulo, 4-5-1900, 1 300 m. Reference: Exell & Mendonça (1954a: 122).

941 Type of *Heeria argyrochrysea* Engl. & Gilg (B. holo. ♀; K, lecto., designated by Fernandes (1966: 45); *BM, *COI, M, W, iso.). Chitanda (right bank), 24-5-1900, 1 150 m.

longipes (Engl. & Gilg) R.Fern. & A.Fern.

512 Type of *Heeria longipes* Engl. & Gilg (B. holo. ♀; BR, COI, K, M, W, Z, iso.). Ungombekike-Kuito, 7-12-1899, 1 200 m.

stenophylla (Engl. & Gilg) R.Fern. & A.Fern.

662 Type of *Heeria stenophylla* Engl. & Gilg (B. holo. ♀; *BM, W, Z, iso.). Longa (left bank), Lazingua, 20-1-1900, 1 250 m. Reference: Exell & Mendonça (1954a: 117).

xylophylla (Engl. & Gilg) R.Fern. & A.Fern.

664 Type of *Heeria xylophylla* Engl. & Gilg (B. holo. ♀; Z, lecto., designated by Fernandes (1966: 48); W, Z, iso.). Quiriri, Sakkemecho, 20-1-1900, 1 200 m.

SEARSIA F.A.Barkley

kirkii (Oliv.) Moffet

638 Type of *Rhus polyneura* Engl. & Gilg (B. holo. ♀; *BM, *COI, K, M, W, Z, iso.). Lazingua (near mouth), 6-1-1900, 1 200 m. Reference: Exell & Mendonça (1954a: 103).

638a Type of *Rhus polyneura* Engl. & Gilg var. *hylophila* Engl. & Gilg (B. holo. ♀). Longa, Minnesera, 1-1900, 1 200 m.

tenuinervis (Engl.) Moffet

744 Type of *Rhus commiphoroides* Engl. & Gilg (B. holo. ♀; *BM, *COI, K, M, W, Z, iso.). Kuito, Onschingue-Kutue, 1-3-1900, 1 200 m. References: Exell & Mendonça (1954a: 102); Kokwaro (1986: 33).

ANISOPHYLLEACEAE

ANISOPHYLLEA R.Br. ex Sabine

quangensis Engl. ex Henriq.

808 Type of *Anisophyllea fruticulosa* Engl. & Gilg (B. holo. ♀; *BM, fragment). Quiriri, Sakkemecho, 9/11? 4-1900, 1 200 m. Reference: Mendes (1970: 41).

ANTHERICACEAE

ANTHERICUM L.

liliagstrum Engl. & Gilg

461 (B. holo. ♀?). Kubango (left bank), Kuimarva (left bank), 11-1899, 1 100 m.

ANTHERICUM L. (cont.)

xylorrhizum Engl. & Gilg

530 (B, holo. ♀?). Kuito (near), 12-1899, 1 150 m.

CHLOROPHYTUM Ker Gawl.

colubrinum (Baker) Engl.

611 Type of *Chlorophytum dolichostachys* Engl. & Gilg (B, holo.). Longa, Napalanka, 1-1-1900, 1 150 m.

psammophilum Engl. & Gilg

517 (B, holo.; COI, M, K, Z, iso.). Ungombekike–Kuito, 9-12-1899, 1 200 m.

APIACEAE

DIPLOLOPHIUM Turcz.

zambesianum Hiern

834 Type of *Physotrichia arenaria* Engl. & Gilg (B, holo. ♀; BM, *COI, G, *K, W, Z, iso.). Lazingua, 19-4-1900, 1 275 m. References: Cannon (1970: 350); Townsend (1989: 83).

APOCYNACEAE

ASCLEPIAS L.

baumii Schltr.

699a (B, holo. ♀). Longa, 3-2-1900, 1 250 m.

ASPIDOGLOSSUM E.Mey.

masaicum (N.E.Br.) Kupicha

413 Type of *Schizoglossum baumii* Schltr. ex N.E.Br. (K, holo.; COI, E, M, W, Z, iso.). Kubango, Kavanga, 17-11-1899, 1 100 m.

CRYPTOLEPIS R.Br.

producta N.E.Br.

457 Type of *Cryptolepis baumii* Schltr. (B, holo. ♀; BM, COI, K, M, W, Z, iso.). Kubango (left bank), Kuimarva (left bank), 23-11-1899, 1 100 m.

LANDOLPHIA P.Beauv.

camptoloba (K.Schum.) Pichon

669 Type of *Carpodinus leucantha* K.Schum. (B, holo. ♀; W, lecto., designated by Persoon *et al.* (1992: 39); G, W, iso.). Longa, Lazingua, 23-1-1900, 1 250 m.

TACAZZEA Decne.

apiculata Oliv.

276 Type of *Tacazzea verticillata* K.Schum. (B, holo. ♀; COI, iso.). Kubango, Chirumbu, 10-1899, 1 200 m.

rosmarinifolia (Decne.) N.E.Br.

245 Type of *Tacazzea salicina* Schltr. (B, holo. ♀; G, lecto., designated by Venter, Verhoeven & Kotze (1990: 107); BM, COI, E, G, K, W, Z, iso.). Nambali, 6-10-1899, 1 280 m.

TYLOPHORA R.Br.

caffra Meisn.

526 Type of *Gymnema melananthum* K.Schum. (B, holo. ♀; BR, COI, K, M, W, Z, iso.). Kuito (near), 12-1899, 1 150 m.

XYSMALOBium R.Br.

undulatum (L.) W.T.Aiton

332 Type of *Asclepias leucotricha* Schltr. (B, holo. ♀; E, W, Z, iso.). Kuebe, 28-10-1899, 1 150 m.

ARACEAE

ZANTEDESCHIA Spreng.

albomaculata (Hook.) Baill. subsp. *albomaculata*

398 Type of *Zantedeschia chloroleuca* Engl. & Gilg (B, holo. ♀?). Kubango (left bank), Kucio, 11-1899, 1 120 m.

ASPARAGACEAE

ASPARAGUS L.

altiscandens Engl. & Gilg

402 (B, holo.; COI, M, S, iso.). Kubango (left bank), Quatiri (left bank), 12-11-1899, 1 100 m.

baumii Engl. & Gilg

150 (B, holo.; COI, M, iso.). Okachitanda (right margin), 25-9-1899.

ASPHODELACEAE

ALOE L.

metallica Engl. & Gilg

891 (B, holo. ♀?). Kutsi, Kapulo, 5-1900, 1 300 m.

nuttii Baker

698 Type of *Aloe brunneo-punctata* Engl. & Gilg (B, holo.; B, BM, BR, COI, E, K, M, iso.). Longa, Quiriri, 2-2-1900, 1 250 m.

zebrina Baker

275 Type of *Aloe baumii* Engl. & Gilg (B, holo. ♀; E, iso.). Kubango, Chirumbu, 14-10-1899, 1 200 m.

BULBINE Wolf

abyssinica A.Rich.

487 Type of *Bulbine xanthobotrys* Engl. & Gilg (B, syn.; W, iso-syn.). Habungu, 28-11-1899, 1 100 m.

731 Type of *Bulbine xanthobotrys* Engl. & Gilg (B, syn.; BR, K, M, S, W, iso.). Quiriri, Kampuluve, 22-2-1900, 1 350 m.

TRACHYANDRA Kunth

arvensis (Schinz) Oberm.

412 Type of *Anthericum pallidiflavum* Engl. & Gilg (B, holo. ♀; BM, K, M, W, iso.). Kubango (left bank), Kavanga, 16-11-1899, 1 100 m.

ASTERACEAE

ANISOPAPPUS Hook. & Arn.

chinensis Hook. & Arn. subsp. *chinensis* var. *chinensis*

877 Type of *Anisopappus gracilis* O.Hoffm. (B, holo. ♀; *COI, K, M, S, W, Z, iso.). Kulei–Kutsi, 29-4-1900, 1 300 m. Reference: Mendonça (1943: 88).

801 Type of *Anisopappus subdiscoides* O.Hoffm. (B, holo. ♀; *COI, K, M, S, W, Z, iso.). Kampuluve, 6-4-1900, 1 200 m. Reference: Mendonça (1943: 88).

ARTEMISIOPSIS S.Moore

villosa (O.Hoffm.) Schweick.

67 Type of *Amphidoxa lasiocephala* O.Hoffm. (B, holo. ♀; W, iso.). Ediva–Humbé, Kakulovar, 6-9-1899, 1 140 m. Reference: Mendonça (1943: 61).

BIDENS L.

baumii (O.Hoffm.) Sherff

883 Type of *Coreopsis baumii* O.Hoffm. (B, holo. ♀; W, lecto., designated by Rayner (1992: 89); BM, *COI, G, *K, M, Z, iso.). Kuma–Kutsi, 5-1900, 1 300 m. Reference: Mendonça (1943: 103).

flabellata O.Hoffm.

847 (B, holo. ♀; G, lecto., designated by Rayner (1992: 82); *BM, *BR, *K, W, Z, iso.). Manonge, Kuebe, 22-4-1900, 1 350 m. Reference: Mendonça (1943: 102).

CONYZA Less.

limosa O.Hoffm.

358 (B, syn. ♀; G, isosyn.). Kubango (right bank), Kucio, 1-11-1899, 1 300 m. Reference: Mendonça (1943: 51).

433 (B, syn. ♀; BM, *COI, G, K, M, W, Z, isosyn.). Maramba, Kalolo, 20-11-1899, 1 100 m. Reference: Mendonça (1943: 51).

welwitschii (S.Moore) Wild

342 Type of *Nidorella linearifolia* O.Hoffm. (B, holo. ♀). Kubango, Kabindere, 30-10-1899, 1 130 m. Reference: Mendonça (1943: 49).

CRASSOCEPHALUM Moench

uvens (Hiern) S.Moore

354 Type of *Senecio telmatophilus* O.Hoffm. (B, holo. ♀; COI, BM, M, W, Z, iso.). Kubango (right bank), Kucio, 11-1899, 1 130 m. Reference: Mendonça (1943: 119).

DICOMA Cass.**anomala** Sond. subsp. **anomala**

804 Type of *Dicoma anomala* Sond. var. *latifolia* O.Hoffm. (B. holo. †; **W**, iso.). Quiriri, Sakkemecho, 9-4-1900, 1 200 m.

933 Type of *Dicoma anomala* Sond. var. *microphylla* O.Hoffm. (B. holo. †). Malolla Katumba–Chibia, 14-6-1900, 1 350 m. Reference: Mendonça (1943: 143).

antunesii O.Hoffm.

926 (B. holo. †; *COI). Kubango–Kassinga, Mundongo, 18-5-1900, 1 400 m. Reference: Mendonça (1943: 140).

EMILIA Cass.**baumii** (O.Hoffm.) S.Moore

707 Type of *Senecio baumii* O.Hoffm. (B. holo. †; **BM**, *COI, **K**, **M**, **W**, **Z**, iso.). Longa, Quiriri, 5-2-1900. Reference: Mendonça (1943: 112).

limosa (O.Hoffm.) C.Jeffrey

907 Type of *Senecio limosus* O.Hoffm. (B. holo. †; *COI, *K, **W**, **Z**, iso.). Kubango, Kohi, 14-5-1900, 1 350 m. Reference: Mendonça (1943: 118).

ERIGERON L.**baumii** O.Hoffm.

187 (B. holo. †; **BM**, *COI, **K**, **M**, **W**, **Z**, iso.). Goudkopje–Kakele, 2-10-1899, 1 210 m. Reference: Mendonça (1943: 46).

ERLANGEA Sch.Bip.**linearifolia** (O.Hoffm.) S.Moore

710 Type of *Bothriocline linearifolia* O.Hoffm. (B. syn. †; *COI, **W**, **Z**, isosyn.). Longa, Quiriri, 2-1900, 1 275 m. Reference: Mendonça (1943: 4).

784 Type of *Bothriocline linearifolia* O.Hoffm. (B. syn. †; *COI, **K**, **M**, **W**, **Z**, isosyn.). Onschingue, Kuito (near), 22-3-1900, 1 200 m. Reference: Mendonça (1943: 4).

GRANGEA Adans.**anthemoides** O.Hoffm.

126 (B. holo. †; **M**, lecto., designated by Fayed (1979: 472); *COI, **W**, **Z**, iso.). Kunene and Chitanda, 21-9-1899, 1 100 m. Reference: Mendonça (1943: 93).

HELICHRYSUM Mill.**congolatum** Schltr. & O.Hoffm.

226 (B. holo. †; *COI, **K**, **M**, **W**, iso.). Kuelleis (Maramba), 5-10-1899, 1 400 m. Reference: Mendonça (1943: 69).

INULA L.**limosa** O.Hoffm.

474 (B. syn. †). Habungu, Maramba, 28-11-1899, 1 100 m. Reference: Mendonça (1943: 77).

630 (B. syn. †; **W**, **Z**, iso.). Longa, Chijija, 5-1-1900, 1 200 m. Reference: Mendonça (1943: 77).

paludosa O.Hoffm.

699 (B. holo. †; *COI, **K**, **W**, **Z**, iso.). Longa, Quiriri, 3-2-1900, 1 250 m. Reference: Mendonça (1943: 77).

MELANTHERA Rohr**triternata** (Klatt) Wild

197 Type of *Melanthera baumii* O.Hoffm. (B. holo. †; **BM**, **COI**, **K**, **W**, iso.). Goudkopje–Kakele, 3-10-1899, 1 238 m. Reference: Mendonça (1943: 97).

NICOLASIA S.Moore**felicioides** S.Moore

50 Type of *Laggera humilis* O.Hoffm. (B. holo. †; **BM**, *COI, **W**, **Z**, iso.). Chihinde, 2-9-1899, 1 270 m. Reference: Mendonça (1943: 57).

NIDORELLA Cass.**resedifolia** DC. subsp. **resedifolia**

47 Type of *Nidorella densiflora* O.Hoffm. (B. holo. †). Chihinde, 2-9-1899, 1 270 m. Reference: Mendonça (1943: 49).

PASACCARDOA Kuntze**baumii** O.Hoffm.

318 (B. holo. †; **K**, **W**, **Z**, iso.). Kuebe (near), 24-10-1899, 1 170 m. Reference: Mendonça (1943: 139).

SENECIO L.**cryphiactis** O.Hoffm.

68 (B. holo. †; **COI**, **K**, **W**, **Z**, iso.). Ediva–Humbe, Kakulovar, 6-9-1899, 1 140 m. Reference: Mendonça (1943: 120).

SPHAERANTHUS L.**flexuosus** O.Hoffm. ex De Wild.

184 Type of *Sphaeranthus humilis* O.Hoffm. (B. holo. †; *COI, **K**, **M**, **W**, iso.). Goudkopje–Kakele, 2-10-1899, 1 210 m. Reference: Mendonça (1943: 61).

VERNONIA Schreb.**brideiifolia** O.Hoffm.

610 (B. holo. †; **W**, **Z**, iso.). Longa, Napalanka, 1-1-1900, 1 150 m. Reference: Mendonça (1943: 30).

gerberiformis Oliv. & Hiern subsp. **macrocyaneus** (O.Hoffm.) C.Jeffrey

134 Type of *Vernonia primulina* O.Hoffm. (B. holo. †; *COI, **M**, **W**, **Z**, iso.). Chitanda (left bank), Kunene, 23-9-1899, 1 108 m. Reference: Mendonça (1943: 29).

limosa O.Hoffm.

255 (B. syn. †; **G**, isosyn.). Nambali, Maramba, 7-10-1899, 1 250 m. Reference: Mendonça (1943: 27).

624 (B. syn. †; **G**, **W**, **Z**, isosyn.). Longa, Chijija, 4-1-1900, 1 200 m. Reference: Mendonça (1943: 27).

mesogramme O.Hoffm.

616 (B. holo. †). Kuairiri, 2-1-1900, 1 150 m. Reference: Mendonça (1943: 35).

pygmaea O.Hoffm.

235 (B. holo. †; **W**, iso.). Maramba, Kuelleis, 5-10-1899, 1 400 m. Reference: Mendonça (1943: 30).

subplumosa O.Hoffm.

703 (B. holo. †; **BM**, **W**, **Z**, iso.). Longa, Quiriri, 3-2-1900, 1 250 m. Reference: Mendonça (1943: 10).

temnolepis O.Hoffm.

929 Type of *Vernonia baumii* O.Hoffm. (B. syn. †; *COI, **K**, **M**, **W**, **Z**, isosyn.). Chitanda, Kassinga, 19-5-1900, 1 325 m. Reference: Mendonça (1943: 25).

929a Type of *Vernonia baumii* O.Hoffm. (B. syn. †; *COI, **W**, isosyn.). Chitanda, Kassinga, 19-5-1900, 1 325 m. Reference: Mendonça (1943: 25).

BORAGINACEAE**TRICHODESMA** R.Br.**baumii** Gürke

844 (B. holo. †; **BM**, **COI**, **E**, **M**, **W**, **Z**, iso.). Manonge, Kuebe, 22-4-1900, 1 350 m.

BRASSICACEAE**RORIPPA** Scop.**cryptantha** (A.Rich.) Robyns & Boutique

129 Type of *Nasturtium microcapsum* Engl. & Gilg (B. holo.; **BM**, **COI**, **K**, iso.). Okachitanda (left bank), 22-9-1899. Reference: Exell & Mendonça (1937a: 50).

BURMANNIACEAE**BURMANNIA** L.**madagascariensis** Mart.

619 Type of *Burmannia bicolor* Mart. var. *micrantha* Engl. & Gilg (B. holo.; **COI**, **S**, iso.). Longa, Chijija, 4-1-1900, 1 200 m.

726 Type of *Burmannia blanda* Engl. & Gilg (B. holo.; **B**, **K**, iso.). Quiriri, Sobi, 20-2-1900, 1 300 m. Reference: Cowley (1988: 2).

CAMPANULACEAE

WAHLENBERGIA Schrad. ex Roth

banksiana A.DC.

- 421 Type of *Wahlenbergia leucantha* Engl. & Gilg (B. holo. †; K. lecto., designated by Thulin (1975: 119); **BM**, **COL**, **G**, **K**, **M**, ***S**, **W**, **Z**, iso.). Kubango (left bank), Kavanga, 18-11-1899, 1 100 m.

denticulata (Burch.) A.DC.

- 837 Type of *Lightfootia laricifolia* Engl. & Gilg (B. holo. †; Z. lecto., designated by Thulin (1975: 116); **G**, **W**, ***Z**, iso.). Lazingua, 19-4-1900, 1 275 m.

undulata (L.f.) A.DC.

- 477 Type of *Wahlenbergia cyanea* Engl. & Gilg (B. holo. †; M. lecto., designated by Thulin (1975: 76); ***BM**, **COL**, **G**, **K**, ***S**, **W**, **Z**, iso.). Habungu, 28-11-1899, 1 100 m.

CAPPARACEAE

BOSCIA Lam.

welwitschii Gilg

- 999 Type of *Boscia suaveolens* Gilg (B. holo. †?; ***BM**, **COL**, ***K**, **M**, **W**, **Z**, iso.). Jau, 19-6-1900, 1 100 m. Reference: Exell & Mendonça (1937b: 65).

CARYOPHYLLACEAE

POLYCARPAEA Lam.

inaequalifolia Engl. & Gilg

- 816 (B. holo. †; ***BM**, **Z**, iso.). Quiriri, Sakkemecho, 4-1900, 1 200 m. Reference: Exell & Mendonça (1937c: 112).

CELASTRACEAE

GYMNOSPORA (Wight & Arn.) Hook.f.

senegalensis (Lam.) Loes.

- 565 Type of *Gymnospora baumii* Loes. (B. holo. †; **BM**, ***COL**, **K**, **W**, **Z**, iso.). Jonkoa, 21-12-1899, 1 150 m. Reference: Exell & Mendonça (1954b: 8).

SALACIA L.

bussei Loes.

- 480 Type of *Salacia rehmanii* Schinz var. *baumii* Loes. (B. holo. †?). Habungu, 11-1899, 1 100 m. Reference: Exell & Mendonça (1954b: 24).

COMBRETACEAE

COMBRETUM Loefl.

aureonitens Engl. & Gilg

- 53 (B. syn. †; **BM**, lecto., designated by Exell & Garcia (1970: 57); **BR**, ***COL**, **K**, **M**, **W**, **Z**, iso.). Chihinde-Ediva, 2-9-1899, 1 250 m.
113 (B. syn. †; **BM**, ***COL**, **K**, **W**, isosyn.). Hartebeest-Löwenpan, 18-9-1899, 1 100 m. Reference: Exell & Garcia (1970: 57).
982 (B. syn. †; ***BM**, ***COL**, **K**, **M**, **W**, isosyn.). Makopi, 11-6-1900. Reference: Exell & Garcia (1970: 57).

collinum Fresen.

- 54 Type of *Combretum monticola* Engl. & Gilg (B. syn. †; **BM**, lecto., designated by Exell & Garcia (1970: 58)). Chihinde-Ediva, 9-1899, 1 250 m.
56 Type of *Combretum monticola* Engl. & Gilg (B. syn. †; **W**, **Z**, isosyn.). Chihinde, 2-9-1899, 1 270 m.
981 Type of *Combretum pachycarpum* Engl. & Gilg (B. syn. †). Makopi, 6-1900, 1 200 m.
983 Type of *Combretum pachycarpum* Engl. & Gilg (B. syn. †; **BM**, lecto., designated by Exell & Garcia (1970: 58); **BR**, ***COL**, **K**, **M**, **S**, **W**, **Z**, iso.). Makopi, 11-6-1900, 1 200 m.
986 Type of *Combretum lacteviride* Engl. & Gilg (B. holo. †; **BM**, lecto., designated by Exell & Garcia (1970: 58); **BR**, ***COL**, **K**, **M**, **S**, **W**, **Z**, iso.). Meschekke-Katumba, 14-6-1900, 1 350 m.

molle R.Br. ex G.Don

- 127 Type of *Combretum arbuscula* Engl. & Gilg (B. syn. †; **BM**, **COL**, **K**, **W**, **Z**, isosyn.). Chitanda (left bank), 21-9-1899, 1 100 m.
155 Type of *Combretum arbuscula* Engl. & Gilg (B. syn. †; **BM**, **K**, **W**, isosyn.). Chitanda (right margin), 25-9-1899, 1 150 m.

- 947 Type of *Combretum arbuscula* Engl. & Gilg (B. syn. †; **BM**, **BR**, **COL**, **K**, **S**, **W**, isosyn.). Chitanda (left bank), 27-5-1900, 1 150 m.

platypetalum Welw. ex M.A.Lawson subsp. *baumii* (Engl. & Gilg) Exell

- 117 Type of *Combretum baumii* Engl. & Gilg (B. syn. †; **BM**, lecto., designated by Exell & Garcia (1970: 73); **BM**, **COL**, **K**, **M**, **W**, **Z**, iso.). Hartebeest-Löwenpan, 18-9-1899, 1 100 m.
119 Type of *Combretum baumii* Engl. & Gilg (B. syn. †). Hartebeest-Löwenpan, 9-1899, 1 100 m.
232 Type of *Combretum arenarium* Engl. & Gilg (B. holo. †; **BM**, lecto., designated by Exell & Garcia (1970: 72); **BM**, **K**, **W**, **Z**, iso.). Kuelleis (Kassinga-Kubango), 5-10-1899, 1 400 m.
232a Type of *Combretum argyrochryseum* Engl. & Gilg (B. holo. †; **BM**, fragment and drawing of holo. [cited by Exell & Garcia (1970: 72)], **W**, iso.). Kuelleis (Kassinga-Kubango), 5-10-1899, 1 400 m.
232b Type of *Combretum gnidioides* Engl. & Gilg (B. holo. †; **BM**, lecto., designated by Exell & Garcia (1970: 72); **W**, **Z**, iso.). Kuelleis (Kassinga-Kubango), 5-10-1899, 1 400 m.

psidioides Welw. subsp. *dinteri* (Schinz) Exell

- 722 Type of *Combretum quirirense* Engl. & Gilg (B. holo. †; **BM**, lecto., designated by Exell & Garcia (1970: 66); **BR**, ***COL**, ***K**, **S**, **W**, **Z**, iso.). Quiriri, Sobi, 19-2-1900, 1 300 m.

TERMINALIA L.

brachystemma Welw. ex Hiern

- 215 Type of *Terminalia baumii* Engl. & Gilg (B. holo. †; **BM**, lecto., designated by Exell & Garcia (1970: 89); ***COL**, **K**, **M**, **W**, **Z**, iso.). Kassinga-Kolove, 4-10-1899, 1 300 m.

COMMELINACEAE

ANEILEMA R.Br.

iplagiocapsa K.Schum.

- 716 (B. holo.; **BM**, **COL**, **G**, **K**, **W**, iso.). Quiriri, Sobi, 18-2-1900, 1 300 m.

COMMELINA L.

milne-redheadii Faden

- 256 Type of *Commelina welwitschii* C.B.Clarke var. *glabra* K.Schum. (B. holo. †; **BM**, **K**, iso.). Nambali, 7-10-1899, 1 250 m.

subulata Roth

- 963 Type of *Commelina elegantula* K.Schum. (B. holo.; **BM**, **M**, iso.). Kitewe-Humbe, 3-6-1900, 1 100 m.

welwitschii C.B.Clarke

- 814 Type of *Commelina filifolia* K.Schum. (B. holo.; **K**, iso.). Quiriri, Sakkemecho, 15/16? 4-1900, 1 200 m.

FLOSCOPA Lour.

flavida C.B.Clarke

- 915 Type of *Floscopa pusilla* K.Schum. (B. holo. †?; **BR**, **K**, **M**, **S**, iso.). Kubango, Kohi, 15-5-1900.

CONVOLVULACEAE

IPOMOEAE L.

crassipes Hook.

- 151 Type of *Ipomoea crassipes* Hook. var. *hirta* Hallier f. (B. syn. †). Chitanda (right margin), 25-9-1899, 1 150 m.
454 Type of *Ipomoea crassipes* Hook. var. *hirta* Hallier f. (B. syn. †; **COL**, **M**, **W**, iso.). Kubango (left bank). Kuimarva, 23-11-1899, 1 100 m.

CRASSULACEAE

KALANCHOE Adans.

brachyloba Welw. ex Britten

- 938 Type of *Kalanchoe baumii* Engl. & Gilg (B. holo. †). Goudkopje, 22-5-1900, 1 300 m.

CUCURBITACEAE

TROCHOMERIA Hook.f.

baumiana Gilg

- 445 (B. holo. †). Kubango (left bank), Kalolo, 11-1899, 1 100 m.

CYPERACEAE

CYPERUS L.

chrysocephalus (K.Schum.) Kük.

311 Type of *Mariscus chrysocephalus* K.Schum. (B, syn. †?; K, isosyn.). Longa, Maschonge, 23-11-1899, 1 170 m.

311a Type of *Mariscus chrysocephalus* K.Schum. (B, syn. †?; COI, isosyn.). Longa, Maschonge, 31-12-1899, 1 150 m.

RHYNCHOSPORA Vahl**holoschoenoides** (Rich.) Herter

355 Type of *Rhynchospora dolichostyla* K.Schum. (B, holo. †?; K, iso.). Kubango (right bank), Kucio, 1-9-1899, 1 130 m.

DICHAPETALACEAE

DICHAPETALUM Thouars**cymosum** (Hook.) Engl.

64 Type of *Dichapetalum venenatum* Engl. & Gilg (B, holo. †; M, lecto., designated by Breteler (1978: 32); **BM, BR, COI, E, K, M, S, W, Z, iso.**). Ediva–Humbe, 6-9-1899, 1 200 m.

DIPSACACEAE

CEPHALARIA Schrad.**retrosetosa** Engl. & Gilg

894 (B, holo. †; **BM, COI, E, K, Z, iso.**). Kutsi, Kapulo, 5-5-1900, 1 300 m.

DIPTEROCARPACEAE

MONOTES A.DC.**dasyanthus** Gilg

888 (B, holo. †; ***BM, *COI, K, M, W, Z, iso.**). Kutsi, 2-5-1900, 1 300 m. Reference: Bancroft (1937: 139).

EBENACEAE

DIOSPYROS L.**batocana** Hiern

780 Type of *Diospyros xanthocarpa* Gürke (B, holo. †; **W, iso.**). Kusi, Likise, 16-3-1900, 1 200 m.

kirkii Hiern

945 Type of *Diospyros baumii* Gürke (B, holo. †; **BR, K, M, W, Z, iso.**). Chitanda (left bank), 26-5-1900, 1 150 m.

virgata (Gürke) Brenan

792 Type of *Maba virgata* Gürke (B, holo. †; **G, iso.**). Onschingue, Kuito (near), 1-4-1900, 1 200 m.

EUCLEA Murray**crispa** (Thunb.) Gürke

191 Type of *Euclea baumii* Gürke (B, holo. †; COI, **K, M, W, Z, iso.**). Goudkopje–Kakele, 10-1899, 1 210 m.

divinorum Hiern

33 Type of *Euclea huillensis* Gürke (B, holo. †; **BR, COI, K, M, S, W, Z, iso.**). Palmfontein, Ediva, 28-8-1899, 1 000 m.

ELATINACEAE

BERGIA L.**pentheriana** Keissl.

98 Type of *Bergia pallide-rosea* Gilg (B, holo. †; ***BM, BR, COI, M, S, W, iso.**). Kunene (left bank), Humbe, 14-9-1899, 1 140 m. Reference: Exell & Mendonça (1937d: 118).

spatulata Schinz

110 Type of *Bergia erythroleuca* Gilg (B, holo. †; ***BM, BR, COI, K, M, S, W, Z, iso.**). Kunene (left bank), Soba Gongo, 17-9-1899, 1 115 m. Reference: Exell & Mendonça (1937d: 119).

EUPHORBIACEAE

JATROPHA L.**baumii** Pax

122a (B, holo. †?). Löwenpan–Kunene, 19-9-1899, 1 100 m.

SCLEROCROTON Hochst.**oblongifolius** (Müll.Arg.) Kruijt & Roebers

257 Type of *Sapium suffruticosum* Pax (B, holo. †?; **BR, COI, E, K, M, W, iso.**). Nambali, Maramba, 10-1899, 1 250 m.

FABACEAE

ADENODOLICHOS Harms**baumii** Harms

848 (B, holo. †; COI, lecto., designated by Torre (1966: 301); **BM, COI, *K, M, Z, iso.**). Manonge, 22-4-1900, 1 350 m.

rhomboides (O.Hoffm.) Harms var. **rhomboides**

872 Type of *Adenodolichos euryphyllus* Harms (B, holo. †; ***COI, BM, K, Z, iso.**). Kulei–Kutsi, 29-4-1900, 1 300 m. Reference: Torre (1966: 300).

AESCHYNOMENE L.**baumii** Harms

810 (B, holo. †; COI, lecto., designated by Torre (1966: 198); **BR, COI, *K, M, S, W, Z, iso.**). Quiriri, Sakkemecho, 10-4-1900, 1 200 m.

bracteosa Welw. ex Baker

252 Type of *Aeschynomene nambalensis* Harms (B, holo. †; **BM, *COI, *K, W, Z, iso.**). Nambali, 7-10-1899, 1 250 m. Reference: Torre (1966: 199).

BAIKIAEA Benth.**plurijuga** Harms

428 (B, holo. †; ***BM, COI, K, M, W, Z, iso.**). Kubango (left bank), Kalolo, 20-11-1899, 1 100 m. Reference: Torre & Hillcoat (1956: 220).

BAPHIA Afzel. ex Lodd.**massaiensis** Taub. subsp. **obovata** (Schinz) Brummitt var. **cornifolia** (Harms) Soladoye

121 Type of *Baphia cornifolia* Harms (B, holo. †; K, lecto., designated by Hillcoat (1966: 376); **BM, *COI, *K, M, W, Z, iso.**). Löwenpan–Kunene, 18-9-1899, 1 100 m.

COPAIFERA L.**baumiana** Harms

523 (B, holo. †; ***BM, COI, K, M, S, W, Z, iso.**). Ungombekike–Kuito, 10-12-1899, 1 200 m. References: Torre & Hillcoat (1956: 243).

CROTALARIA L.**angulicaulis** Harms

740 (B, holo. †; **BM, iso.**). Kampuluve, 2-1900, 1 200 m.

baumii Harms

836 (B, holo. †; **BM, COI, K, W, M, S, Z, iso.**). Lazingua, 19-4-1900, 1 275 m. Reference: Torre (1962: 35).

densicephala Welw. ex Baker

670 Type of *Crotalaria lachnoclada* Harms (B, holo. †; **BM, COI, K, M, S, W, Z, iso.**). Longa, Lazingua, 23-1-1900, 1 250 m. Reference: Torre (1962: 63).

leptoclada Harms var. **leptoclada**

829 (B, holo. †; **BM, COI, K, LISC, M, W, Z, iso.**). Longa, 18-4-1900, 1 275 m. Reference: Torre (1962: 66).

psammophila Harms

741 (B, holo. †; **BM, COI, K, M, S, W, Z, iso.**). Kampuluve, Kuito (near), 27-2-1900, 1 200 m. Reference: Torre (1962: 29).

sericifolia Harms

483 (B, holo. †; **BM, COI, K, M, W, Z, iso.**). Habungu, 28-11-1899, 1 100 m. Reference: Torre (1962: 67).

subsessilis Harms

787 (B, holo. †; **BM, COI, K, M, W, Z, iso.**). Onschingue, Kuito (near), 29-3-1900, 1 200 m. Reference: Torre (1962: 67).

ENTADA Adans.**arenaria** Schinz subsp. **arenaria**

471 Type of *Entada nana* Harms (B, holo. †; **W, Z, iso.**). Habungu, 28-11-1899, 1 100 m.

ERYTHRINA L.

baumii Harms

223 (B, holo. †; BM, lecto., designated by Torre (1966: 248); E, NY, W, iso.). Kuelleis (Maramba), 5-10-1899, 1 400 m.

INDIGOFERA L.

baumiana Harms

497 (B, syn. †; BM, BR, COI, E, K, M, W, Z, isosyn.). Habungu, 1-12-1899, 1 150 m. Note: Torre (1962: 118) referred to the B specimen as holotype (because it was the first of the two syntypes cited in the protologue) which would make it a lectotype. However, he did not see the specimen (having referred to it as n.v.). Therefore, we think this cannot be considered a lectotypification.

819 (B, syn. †). Quiriri, Sakamecho, 4-1900, 1 200 m.

griseoides Harms

745 (B, holo. †; E, W, iso.). Kuito, Onschingue–Kutue, 1-3-1900, 1 200 m.

nambalensis Harms

254 (B, holo. †). Nambali, 10-1899, 1 250 m.

JULBERNARDIA Pellegr.

paniculata (Benth.) Troupin

732 Type of *Berlinia baumii* Harms (B, holo. †; BM, COI, K, M, iso.). Onschingue, Kuito, 22-2-1900, 1 200 m. Reference: Torre & Hillcoat (1956: 212).

PHYSOSTIGMA Balf.

mesoponticum Taub.

133 Type of *Physostigma mesoponticum* Taub. var. *baumii* Harms (B, holo. †; COI, lecto., designated by Torre (1966: 260); *BM, E, K, iso.). Chitanda (left bank), 23-9-1899, 1 108 m.

RHYNCHOSIA Lour.

baumii Harms

764 (B, holo. †; Z, lecto., designated by Torre (1965: 223); S, W, Z, iso.). Kuito, Kutue–Sobi, 4-3-1900, 1 200 m.

luteola (Hiern) K.Schum.

1005a Type of *Rhynchosia moninensis* Harms (B, holo. † *BM, *COI, *K, W, Z, iso.). Monino, Nevis, 23-6-1900, 350 m. Reference: Torre (1966: 316).

SESBANIA Scop.

coerulescens Harms

782 (B, holo. †; K, M, W, Z, iso.). Miané, Kavamba, 14-3-1900, 1 175 m. Reference: Sousa (1962: 184).

microphylla Harms

569 (B, holo. †; K, Z, iso.). Longa (mouth), 22-12-1899, 1 130 m. Reference: Sousa (1962: 186).

TEPHROSIA Pers.

cephalantha Welw. ex Baker

563 Type of *Tephrosia hypargyrea* Harms (B, holo. †; *BM, COI, *K, M, W, Z, iso.). Jonkoa, 20-12-1899, 1 150 m. Reference: Torre (1962: 164).

coronilloides Welw. ex Baker

612 Type of *Tephrosia longana* Harms (B, holo. †; BM, COI, K, W, Z, iso.). Longa, Napalanka, 1-1-1900, 1 150 m. Reference: Torre (1962: 155).

FLACOURTIACEAE

XYLOTHECA Hochst.

longipes (Gilg) Gilg

388 Type of *Ocoba longipes* Gilg (B, holo. †; G, iso.). Kubango (right bank), Kucio, 5-11-1899, 1 100 m. Reference: Sleumer (1937: 81).

GENTIANACEAE

CHIRONIA L.

baumiana Gilg

739 (B, holo. †; COI, E, K, M, W, Z, iso.). Kampuluve, 26-2-1900, 1 210 m.

NEUROTHECA Salisb. ex Benth.

congolana De Wild. & T.Durand

604 Type of *Neurothea baumii* Gilg (B, holo. †; COI, E, K, M, S, W, Z, iso.). Longa, Napalanka, 1-1900, 1 150 m.

PYCNOSPHAERA Gilg

buchananii (Baker) N.E.Br.

752 Type of *Pycnosphaera trimera* Gilg (B, holo. †; COI, E, K, M, S, W, Z, iso.). Kuito, Kutue, 2-3-1900, 1 200 m.

SEBAEA Sol. ex R.Br.

baumiana (Gilg) Boutique

692 Type of *Belmontia baumiana* Gilg (B, holo. †; COI, E, W, Z, iso.). Longa, Quiriri, 2-2-1900, 1 250 m.

teuszii (Schinz) P.Taylor

316 Type of *Belmontia chionantha* Gilg (B, syn. †; *K, isosyn.). Kuebe (near), 10-1899, 1 170 m. Reference: Nemomissa (2002: 18).

702 Type of *Belmontia chionantha* Gilg (B, syn. †; E, *K, W, isosyn.). Longa, Quiriri, 3-2-1900, 1 250 m. Reference: Nemomissa (2002: 18).

838 Type of *Belmontia chionantha* Gilg (B, syn. †; COI, E, K, M, W, Z, isosyn.). Lazingua, 19-4-1900, 1 300 m. Reference: Nemomissa (2002: 18).

HYACINTHACEAE

DIPCADI Medik.

longifolium (Lindl.) Baker

499 Type of *Dipcadi anthericoides* Engl. & Gilg (B, holo.; COI, K, M, iso.). Bondo, 2-12-1899, 1 150 m.

vaginatum Baker

349 Type of *Dipcadi baumii* Engl. & Gilg (B, holo.). Kubango, Kabindere, 30-10-1899, 1 150 m.

viride (L.) Moench

459 Type of *Dipcadi lividescens* Engl. & Gilg (B, holo.). Kubango (left bank), Kuimarva, 23-11-1899, 1 100 m.

LEDEBOURIA Roth

revoluta (L.f.) Jessop

203a Type of *Scilla lanceifolia* (Jacq.) Baker var. *longiracemosa* Engl. & Gilg (B, syn. †?). Kakele, Kassinga, 10-1899, 1 250 m.

447 Type of *Scilla lanceifolia* (Jacq.) Baker var. *longiracemosa* Engl. & Gilg (B, syn. †?). Kubango (left bank), Kalolo, 11-1899, 1 100 m.

SCHIZOCARPUS Van der Merwe

nervosus (Burch.) Van der Merwe

410 Type of *Scilla eriospermoides* Engl. & Gilg (B, holo.; COI, K, M, iso.). Kubango (left bank), Kavanga, 16-11-1899, 1 100 m.

SCILLA L.

baumiana Engl. & Gilg

122 (B, holo.; COI, K, Z, iso.). Lövenpan–Kunene, 19-9-1899, 1 100 m.

HYDROCHARITACEAE

OTTELIA Pers.

kunenensis (Gürke) Dandy

962 Type of *Boottia kunenensis* Gürke (B, holo. †?; COI, K, M, W, iso.). Kunene, Kitwe–Humbe, 3-6-1900, 1 100 m.

muricata (C.H.Wright) Dandy

772 Type of *Boottia aschersonianiana* Gürke (B, holo. †?; COI, M, W, iso.). Kuito, Kutue–Sobi, 10-3-1900, 1 200 m.

ulvifolia (Planch.) Walp.

120 Type of *Ottelia benguelensis* Gürke (B, holo. †?; W, iso.). Lövenpan, 18-9-1899, 1 100 m.

858 Type of *Ottelia baumii* Gürke (B, holo. †?; COI, K, W, iso.). Manongc, 23-4-1900, 1 350 m.

HYDROSTACHYACEAE

HYDROSTACHYS Thouars

triaxialis Engl. & Gilg

263 (B, holo. †; **BM**, **COL**, **K**, **M**, **W**, **Z**, iso.). Kubango, Massaca, 8-10-1899, 1 200 m.

HYPERICACEAE

HYPERICUM L.

lalandii Choisy

909 Type of *Hypericum baumii* Engl. & Gilg (B, holo. †). Kubango, Kohi, 5-1900, 1 350 m. References: Exell & Mendonça (1937: 120); Milne-Redhead (1953: 9).

IRIDACEAE

GLADIOLUS L.

benguellensis Baker

632 Type of *Gladiolus longanus* Harms (B, holo.; **BM**, **E**, **Z**, iso.). Longa, Chijija, 5-1-1900, 1 200 m.

magnificus (Harms) Goldblatt

651 Type of *Antholyza magnifica* Harms (B, holo.; **COL**, **M**, **W**, iso.). Longa, Minnesera, 11-1-1900, 1 250 m.

pallidus Baker

881 Type of *Gladiolus baumii* Harms (B, holo.). Kulei-Kutsi, 30-4-1900, 1 300 m.

898 Type of *Gladiolus kubangensis* Harms (B, holo.; **COL**, **E**, **M**, **S**, **Z**, iso.). Kubango (near), 8-5-1900, 1 450 m.

IXONANTHACEAE

PHYLLOCOSMUS Klotzsch

lemaireanus (De Wild. & T.Durand) T.Durand & H.Durand

712 Type of *Phyllocosmus candidus* Engl. & Gilg (B, holo. †; **BM**, **COL**, **K**, **W**, **Z**, iso.). Quiriri, Sakkemecho, 13-2-1900, 1 300 m. References: Exell & Mendonça (1951a: 247); Verdcourt (1984: 4).

LAMIACEAE

AEOLLANTHUS Mart. ex K.Spreng.

engleri Briq.

737 Type of *Aeolanthus paludosus* Gürke (B, holo. †; **COL**, **E**, **K**, **W**, **Z**, iso.). Kampuluve, 26-2-1900, 1 210 m.

866 Type of *Aeolanthus uliginosus* Gürke (B, holo. †; **COL**, **E**, **K**, **M**, **S**, **W**, iso.). Chimpungu, 25-4-1900, 1 400 m.

BENGUELLIA G.Taylor

lanceolata (Gürke) G.Taylor

910 Type of *Orthosiphon lanceolatus* Gürke (B, holo. †; **COL**, **M**, **W**, iso.). Kubango, Kohi, 15-5-1900, 1 350 m.

CLERODENDRUM L.

baumii Gürke

661 (B, holo. †; **E**, **W**, **Z**, iso.). Longa (left bank), Lazingua, 20-1-1900, 1 250 m.

PLATOSTOMA P.Beauv.

strictum (Hiern) A.J.Paton

644 Type of *Geniosporum baumii* Gürke (B, holo. †; **BM**, **COL**, **K**, **M**, **S**, **W**, iso.). Lazingua, near Longa, 7-1-1900, 1 130 m.

PLECTRANTHUS L'Hér.

baumii Gürke

283 (B, holo. †; **COL**, **W**, **Z**, iso.). Kubango, Massaca, 19-10-1899, 1 150 m.

betonicifolius Baker

544 Type of *Coleus baumii* Gürke (B, holo. †; **BM**, **COL**, **K**, **M**, **S**, **W**, **Z**, iso.). Kuito, 14-12-1899, 1 150 m.

guerkei Briq.

789 Type of *Hyptis baumii* Gürke (B, holo. †; **COL**, **E**, **M**, **W**, **Z**, iso.). Onschingue, Kuito (near), 1-4-1900, 1 200 m.

TINNEA Kotschy & Peyr.

benguellensis Gürke

697 (B, holo. †; **BM**, **COL**, **E**, **K**, **M**, **W**, **Z**, iso.). Longa, Quiriri, 2-2-1900, 1 250 m.

coerulea Gürke var. *coerulea*

857 (B, holo. †; **BM**, **G**, **K**, **M**, **W**, **Z**, iso.). Manonge, Kuebe, 23-4-1900, 1 350 m.

vestita Baker

695 Type of *Timea fusco-luteola* Gürke (B, holo. † **BM**, **COL**, **E**, **G**, **K**, **M**, **W**, **Z**, iso.). Longa, Quiriri, 2-2-1900, 1 250 m.

LENTIBULARIACEAE

UTRICULARIA L.

spiralis Sm.

307 Type of *Utricularia baumii* Kamienski (B, holo. †; ***BM**, ***BR**, **COL**, **G**, ***HBG**, **K**, ***M**, ***S**, **W**, **Z**, iso.). Kuebe (near), 23-10-1899, 1 170 m. Reference: Taylor (1973: 8).

subulata L.

691 Type of *Utricularia angolensis* Kamienski (B, holo. †; **K**, iso.). Longa, Quiriri, 2-2-1900, 1 250 m.

LOBELIACEAE

LOBELIA L.

angolensis Engl. & Diels ex Diels

43 Type of *Lobelia minutidentata* Engl. & Gilg (B, holo.; ***BM**, **COL**, **G**, ***K**, **M**, ***S**, **W**, **Z**, iso.). Chihinde, 2-9-1899, 1 270 m. Note: although the holotype has been reported as destroyed, e.g. Thulin (1984: 45), it has recently been found.

MONOPSIS Salisb.

zeyheri (Sond.) Thulin

144 Type of *Lobelia fonticola* Engl. & Gilg (B, holo. †; **G**, lecto., designated by Thulin (1979: 135); ***BM**, **COL**, **K**, **M**, **S**, **W**, iso.). Chitanda (left bank), 24-9-1899. Reference: Thulin (1984: 49).

LORANTHACEAE

AGELANTHUS Tiegh.

terminaliae (Engl. & Gilg) Polhill & Wiens

519 Type of *Loranthus terminaliae* Engl. & Gilg (B, holo.; **K**, **Z**, iso.). Ungombekike-Kuito, 9-12-1899, 1 200 m. Reference: Gebauer (1993).

PHRAGMANTHERA Tiegh.

baumii (Engl. & Gilg) Polhill & Wiens

217 Type of *Loranthus baumii* Engl. & Gilg (B, holo.; **COL**, **K**, **Z**, iso.). Kassinga-Kolove, 4-10-1899, 1 300 m. Reference: Gebauer (1993).

LYTHRACEAE

NESAEA Kunth

baumii Koehne

204 (B, holo. †; **COL**, lecto., designated by Fernandes & Fernandes (1970: 185); **K**, **M**, **W**, **Z**, iso.). Kakele, 3-10-1899, 1 250 m.

MALPIGHIACEAE

SPHEDAMNOCARPUS Planch. ex Benth. & Hook.f.

angolensis (A.Juss.) Planch. ex Oliv.

588 Type of *Sphedamnocarpus pulcherrimus* Engl. & Gilg (B, holo. †; ***BM**, **BR**, ***COL**, **K**, **M**, **W**, **Z**, iso.). Longa, Napalanka, 28-12-1899, 1 150 m. Reference: Exell & Mendonça (1951b: 252).

MALVACEAE

PAVONIA Cav.

senegalensis (Cav.) Leistner

760 Type of *Hibiscus baumii* Gürke (B, holo. †; **BM**, **COL**, ***K**, **M**, **W**, **Z**, iso.). Kuito, Kutue-Sobi, 4-3-1900, 1 200 m. Reference: Exell & Mendonça (1937f: 157).

MELIACEAE

ENTANDROPHRAGMA C.DC.

ekebergioides (Harms) Sprague

88 Type of *Wulffhorstia ekebergioides* Harms (B, holo. †?; *BM, COI, E, K, M, W, iso.). Humbe, 10-9-1899, 1 200 m. Reference: Exell & Mendonça (1951c: 309).

MENISPERMACEAE

TINOSPORA Miers

caffra (Miers) Troupin

540 Type of *Desmonema pallide-aurantiacum* Engl. & Gilg (B, holo.; *BM, BR, COI, E, G, K, M, S, Z, iso.). Kuito, Onjimba, 13-12-1899, 1 150 m. Reference: Exell & Mendonça (1937g: 39).

NYMPHAEACEAE

NYMPHAEA L.

sulphurea Gilg

325 (B, syn.; Z, isosyn.). Kuebe (near), 26-10-1899, 1 150 m. Reference: Exell & Mendonça (1937h: 48).

657 (B, syn.; *BM, *COI, K, isosyn.). Longa (left bank), Minnesera, 17-1-1900, 1 250 m. Reference: Exell & Mendonça (1937h: 48).

OCHNACEAE

OCHNA L.

arenaria De Wild. & T.Durand

813 Type of *Ochna roseiflora* Engl. & Gilg (B, lecto., designated by Exell & Mendonça (1951d: 285)†; K, W, isolecto.). Chimpungu–Kulei, 11-4-1900, 1 350 m. Note: Exell & Mendonça (1951d: 285) cited the two syntype collections 813 and 813a, but referred to the B duplicate of no. 813 as type, which is thus the lectotype. However, this specimen was destroyed. Verdcourt (2005) cited Baum 813 (B) as holotype.

813a Type of *Ochna roseiflora* Engl. & Gilg (B, syn. †; BM, E, isosyn.). Quiriri, Sakkemecho, 11-4-1900, 1 200 m. Reference: Exell & Mendonça (1951d: 285).

cinnabarina Engl. & Gilg

550 (B, holo. †; E, W, Z, iso.). Kuito, Longa, 16-12-1899, 1 150 m. Reference: Exell & Mendonça (1951d: 292).

pulchra Hook.

114 ? Type of *Ochna antunesii* Engl. & Gilg (B, holo. †; COI, K, P, W, Z, iso.). Hartbeest–Löwenpan, 18-9-1899, 1 100 m. Note: although the description in Warburg (1903) is based on this collection, the name had been previously considered a synonym by Tieghem (see Exell & Mendonça 1951d: 291) and the type may be a specimen collected by Antunes.

145 Type of *Ochna brunnescens* Engl. & Gilg (B, holo. †; BM, COI, E, K, P, Z, iso.). Chitanda (left bank), 24-9-1899, 1 150 m. Note: the name had been previously considered a synonym by Tieghem (see Exell & Mendonça 1951d: 291).

pygmaea Hiern

172 Type of *Ochna hoepfneri* Engl. & Gilg (B, lecto., designated by Exell & Mendonça (1951d: 287)†; BM, BR, *COI, K, M, P, W, iso.). Chitanda (right margin), 27-9-1899, 1 150 m. Note: Exell & Mendonça (1951d: 287) cite the two syntypes 172 and 220 but designate the B duplicate of the former as type (i.e. lectotype). This was apparently destroyed.

220 Type of *Ochna hoepfneri* Engl. & Gilg (B, syn. †; BM, COI, K, M, P, W, Z, isosyn.). Kuellcis (Maramba), 5-10-1899, 1 400 m. Reference: Exell & Mendonça (1951d: 287).

SAUVAGESIA L.

africana (Baill.) Bamps

620 Type of *Vausagesia bellidifolia* Engl. & Gilg (B, holo. †; BM, COI, E, G, K, M, W, Z, iso.). Longa, Chijija, 4-1-1900, 1 200 m. Reference: Exell & Mendonça (1951d: 284).

ONAGRACEAE

LUDWIGIA L.

senegalensis (DC.) J.Troch.

97 Type of *Ludwigia pulvinaris* Gilg (B, holo. †; COI, lecto., designated by Fernandes & Fernandes (1970: 196); G, K, M, W, Z, iso.). Kunene (left bank), Humbe, 12-9-1899, 1 066 m.

ORCHIDACEAE

BRACHYCORYTHIS Lindl.

angolensis (Schltr.) Schltr.

326 Type of *Platanthera angolensis* Schltr. (B, holo. †; BM, *COI, E, K, M, S, W, iso.).

Kuebe, 26-10-1899, 1 150 m. Reference: Summerhayes (1968: 21).

614 Type of *Brachycorythis oligophylla* Kraenzl. (B, holo. †; BM, W, iso.). Longa, Napalanka, 1-1-1900, 1 150 m.

rhodostachys (Schltr.) Summerh.

381 Type of *Platanthera rhodostachys* Schltr. (B, syn. †; *BM, E, W, isosyn.). Kubango, Kueio, 4-11-1899, 1 120 m. Note: Summerhayes (1968: 18) cited the collection 381 at B as holotype. In fact, there were two syntypes, 381 and 629. The 381 duplicate cited as holotype was also reported as destroyed, therefore this is not considered a lectotypification.

629 Type of *Platanthera rhodostachys* Schltr. (B, syn. †; W, isosyn.). Longa, Chijija, 5-1-1900, 1 200 m.

EULOPHIA R.Br. ex Lindl.

adenoglossa (Lindl.) Rchb.f.

505 Type of *Eulophia bauniana* Kraenzl. (B, holo. †?; K, W, iso.). Ungombekike, 5-12-1899, 1 200 m. Note: the holotype is cited by Cribb (1989: 455) as seen; however, it is not available in Aluka nor in the B website.

arenicola Schltr.

384 (B, holo. †; COI, E, K, M, W, iso.). Kubango, Kueio, 11-1899, 1 120 m.

calantha Schltr.

382 Type of *Eulophia calantha* Schltr. var. *kubangensis* Schltr. (B, holo. †). Kubango, Kueio, 4-11-1899, 1 120 m. Reference: Cribb (1989: 435).

631 (B, holo. †; BM, COI, E, *G, *K, M, S, W, iso.). Longa, Chijija, 5-1-1900, 1 200 m. Reference: Cribb (1989: 434).

coeloglossa Schltr.

367 (B, holo. †; BM, COI, E, *G, K, M, S, W, iso.). Kubango, Kueio, 11-1899, 1 120 m. Reference: Cribb (1989: 435).

corymbosa Schltr.

377 (B, holo. †; E, K, M, S, W, iso.). Kubango, Kueio, 4-11-1899, 1 120 m.

gonychila Schltr.

261 (B, holo. †). Nambali, Kubango (near), 7-10-1899, 1 200 m. Reference: Cribb (1989: 471).

malangana (Rchb.f.) Summerh.

496 Type of *Eulophia warburgii* Schltr. (B, holo. †; COI, E, K, M, S, W, iso.). Habungu, 30-11-1899, 1 100 m. Reference: Cribb (1989: 434).

rolfeana Kraenzl.

369 (B, holo. †). Kubango (right bank), Kueio (mouth), 3-11-1899.

tricristata Schltr.

357 (B, holo. †; COI, K, M, S, W, iso.). Kubango, Kabindere, 30-11-1899, 1 130 m.

trilamellata De Wild.

341 Type of *Eulophia macra* Schltr., *nom. illeg.* (B, holo. †?; COI, K, M, S, W, *Z, iso.). Kubango, Kabindere, 10-1899, 1 130 m. Note: the holotype is cited by Cribb (1989: 455) as seen; however, it is not available in Aluka nor in the B website.

HABENARIA Willd.

holothrix Schltr.

578 (B, holo. †; BM, COI, K, M, *S, W, Z, iso.). Longa, Napalanka, 12-1899, 1 150 m. Reference: Summerhayes (1968: 122).

holubii Rolfe

598 Type of *Habenaria rhopaloceras* Schltr. (B, holo. †; BM, *COI, K, M, W, Z, iso.). Maschonge, Napalanka, 28-12-1899, 1 150 m. Reference: Summerhayes (1968: 110).

huillensis Rchb.f.

425 Type of *Habenaria kubangensis* Schltr. (B, holo. †; BM, M, S, W, Z, iso.). Kubango, Kavanga–Kalolo, 19-11-1899, 1 100 m.

macroplectron Schltr.

603 (B, holo. †; BM, K, M, S, W, Z, iso.). Longa, Napalanka, 1-1-1900, 1 150 m.

HABENARIA Willd. (cont.)**verdickii** (De Wild.) Schltr.

561 Type of *Habenaria monophylla* Schltr., *nom. illeg.* (B, holo. †; **BM, K, M, S, W, Z**, iso.). Jonkoa, 20-12-1899, 1 150 m.

PHAIUS Lour.**occidentalis** Schltr.

374 (B, holo. †). Kubango, Kueio, 3-11-1899, 1 120 m. Reference: Cribb (1984: 281).

POLYSTACHYA Hook.**dendrobii**flora Rechb.f.

839 Type of *Polystachya holochila* Schltr. (B, holo. †; **COL, G, K, M, S, W**, iso.). Lazingua, 20-4-1900, 1 300 m. Reference: Cribb (1984: 286).

SATYRIUM Sw.**oliganthum** Schltr.

383 Type of *Satyrium paludosum* Rechb.f. var. *parvibracteatum* Schltr. (B, holo. †; **K, W**, iso.). Kubango, Kueio, 4-11-1899, 1 120 m.

OROBANCHACEAE**BUCHNERA** L.**baumii** Engl. & Gilg

225 (B, holo. †; **COL, G, K, M, W, Z**, iso.). Kuelleis (Maramba), 5-10-1899, 1 400 m.

proprepens Engl. & Gilg

875 (B, holo. †; **COL, G, K, M, W**, iso.). Kulei-Kutsi, 29-4-1900, 1 300 m.

strictissima Engl. & Gilg

734 (B, holo. †; **BM, COL, K, M, W**, iso.). Kampuluve (at source), 25-2-1900, 1 210 m.

CYCNIUM E.Mey. ex Benth. emend. Engl.**tubulosum** (L.f.) Engl. subsp. **tubulosum**

403 Type of *Cycnium hamatum* Engl. & Gilg (B, holo. †; **BM**, lecto., designated by Jansen (1978: 34); **COL, HBG, K, W**, iso.). Quatiri (mouth), 13-11-1899, 1 100 m.

HARVEYA Hook.**andogensis** Hiern

869 Type of *Harveya macrantha* Engl. & Gilg (B, holo. †; **COL, E, K, M, W**, iso.). Kulei, 26-4-1900, 1 300 m.

SOPUBIA Buch.-Ham. ex D.Don**mannii** Skan

475 Type of *Sopubia dregeana* Benth. var. *tenuifolia* Engl. & Gilg (B, holo. †; **COL, E, G, K, M, W**, iso.). Habungu, Maramba, 28-11-1899, 1 100 m.

PASSIFLORACEAE**BASANANTHE** Peyr.**baumii** (Harms) W.J.de Wilde

391 Type of *Trypsohemma baumii* Harms (B, holo. †?; ***BM, *COL, G, *K, M, W, Z**, iso.). Kubango (right bank), Kueio (right bank), 7-11-1899, 1 120 m.

PEDALIACEAE**SESAMUM** L.**calycinum** Welw. subsp. **repens** (Engl. & Gilg) Seidenst.

660 Type of *Sesamum repens* Engl. & Gilg (B, holo. †; **K, W**, iso.). Longa (left bank), Lazingua, 20-1-1900, 1 250 m.

POACEAE**ELYTROPHORUS** P.Beauv.**globularis** Hack.

112 Type of *Elytrophorus interruptus* Pilg. (B, holo. †?; **BM, K, M, W**, iso.). Kunene (left bank), Soba Gongo (near), 17-9-1899, 1 115 m.

SPOROBOLUS R.Br.**welwitschii** Rendle

511 Type of *Sporobolus baumianus* Pilg. (B, holo. †?; **M**, iso.). Ungombekike, 5-12-1899, 1 200 m.

PODOSTEMACEAE**LEDERMANNIELLA** Engl.**warmingiana** (Gilg) C.Cusset

904 Type of *Sphaerostylax warmingiana* Gilg (B, holo. †; **BM, COL, K, M, W, Z**, iso.). Kubango, Menemprem, 11-5-1900, 1 300 m.

POLYGALACEAE**POLYGALA** L.**arenicola** Gürke

301 (B, holo. †; **BM**, lecto., designated by Paiva (1998: 235); ***COL, E, K, M, W, Z**, iso.). Kuebe, 23-10-1899, 1 170 m. Reference: Exell & Mendonça (1937i: 107).

baumii Gürke

815 (B, holo. †; **BM**, lecto., designated by Paiva (1998: 231); **BR, *COL, E, K, M, W, Z**, iso.). Quiriri, Sakkemecho, 16-4-1900, 1 200 m. Reference: Exell & Mendonça (1937i: 106).

kalaxariensis Schinz

287 Type of *Polygala kubangensis* Gürke (B, holo. †; **BM, *COL, E, *K, M, W**, iso.). Kubango, Massaca, 19-10-1899, 1 150 m. References: Exell & Mendonça (1937i: 106); Paiva (1998: 234).

nambalensis Gürke

244 (B, holo. †; **BM**, iso.). Nambali (Maramba), 6-10-1899, 1 275 m. Reference: Exell & Mendonça (1937i: 99).

817 Type of *Polygala psammophila* Gürke, *nom. illeg.* (B, syn. † **BM, *COL, *K, W**, isosyn.). Quiriri, Sakkemecho, 16-4-1900, 1 200 m. Reference: Exell & Mendonça (1937i: 99).

871 Type of *Polygala psammophila* Gürke, *nom. illeg.* (B, lecto., designated by Exell & Mendonça (1937i: 99) †; **BM, *COL, K, M, W**, iso.). Kulei-Kutsi, 29-4-1900, 1 300 m. Note: Exell & Mendonça (1937i) cited the two syntypes 817 and 871, but they indicated the B duplicate of the latter as type, making it a lectotype. This specimen was later destroyed.

paludicola Gürke

315a (B, syn. †). Kuebe, 23-10-1899, 1 170 m.

373 (B, lecto., designated by Exell & Mendonça (1937i:100)†; **BM**, lecto., designated by Paiva (1998: 209) without collection number; **E, K, W**, isoelecto.). Kubango (right bank), Kueio (mouth), 3-11-1899, 1 120 m. Note: Exell & Mendonça (1937i: 100) cited the three syntype collections, 373, 373a and 315a, referring to the B duplicate of the first as type. However, this duplicate was later destroyed. Paiva (1998) indicated as lectotype the duplicate at BM of a Baum collection from R.Cubango but the number was omitted. It is assumed that it is no. 373, since the other two syntype collections are from other localities.

373a (B, syn. †; **BM, *COL, E, *K, W, Z**, isosyn.). Longa, Maschonge, 30-12-1899, 1 120 m. Reference: Exell & Mendonça (1937i: 100).

rivularis Gürke

595 (B, syn. †; ***BM, *COL, K, W, Z**, isosyn.). Maschonge, Napa-lanka, 28-12-1899, 1 150 m. Reference: Exell & Mendonça (1937i: 105).

911 (**BM**, lecto., designated by Paiva (1998: 224); ***COL, E, K, W, Z**, iso.). Kubango, Kohi, 15-5-1900, 1 350 m. Note: Exell & Mendonça (1937i: 105) cited the two syntype collections 595 and 911, referring to the B duplicate of the latter as type. This specimen was later destroyed. The BM duplicate was later designated as lectotype by Paiva (1998).

robusta Gürke

704 Type of *Polygala robusta* Gürke var. *coerulea* Gürke (B, holo. †; **BM**, lecto., designated by Paiva (1998: 230); **BM, BR, *COL, E, K, M, W, Z**, iso.). Longa, Quiriri, 3-2-1900, 1 275 m. Reference: Exell & Mendonça (1937i: 106). Note: this is the lectotype of *P. robusta*.

704a Type of *Polygala robusta* Gürke var. *rubra* Gürke (B, holo. †). Quiriri, Sakkemecho, 15-4-1900, 1 200 m. References: Exell & Mendonça (1937i: 106); Paiva (1998: 230).

POLYGALA L. (cont.)**schinziana** Chodat

554 Type of *Polygala benguelensis* Gürke (B, holo. †; **BM**, ***COL**, ***K**, **W**, **Z**, iso.). Jonkoa, 17-12-1899, 1 150 m. References: Exell & Mendonça (1937i: 104); Paiva (1998: 219).

PRIMULACEAE**ANAGALLIS L.****filifolia** Engl. & Gilg

906 (B, holo. †; **COL**, **E**, **M**, **S**, **W**, **Z**, iso.). Kubango, Kohi, 14-5-1900, 1 350 m.

PROTEACEAE**FAUREA** Harv.**intermedia** Engl. & Gilg

912 (B, holo.; ***BR**, **COL**, **E**, **K**, **M**, iso.). Kubango, Kohi, 15-5-1900, 1 350 m. Reference: Brummitt & Marner (1993: 7).

PROTEA L.**angolensis** Welw. var. **angolensis**

863 Type of *Protea chionantha* Engl. & Gilg var. *typica* Engl. & Gilg (B, holo. [of *P. chionantha*]; **BM**, **COL**, **E**, **G**, **K**, **M**, **Z**, iso.). Chimpungu–Kulci, 25-4-1900, 1 400 m.

angolensis Welw. var. **divaricata** (Engl. & Gilg) Beard

920 Type of *Protea chionantha* Engl. & Gilg var. *divaricata* Engl. & Gilg (B, holo.; **BM**, **COL**, **E**, **G**, **K**, **M**, **Z**, iso.). Kubango–Kassinga, 17-5-1900, 1 400 m.

baumii Engl. & Gilg subsp. **baumii**

375 (B, holo.; **BM**, **E**, **G**, **M**, **Z**, iso.). Kubango (right bank), Kueio (mouth), 3-11-1899, 1 100 m.

gaguedi J.F.Gmel.

272 Type of *Protea chrysolepis* Engl. & Gilg (B, holo.; **BM**, **COL**, **E**, **G**, **M**, **Z**, iso.). Kubango, Chirumbu, 14-10-1899, 1 200 m.

lemairei De Wild. subsp. **trichophylla** (Engl. & Gilg) Beard

918 Type of *Protea trichophylla* Engl. & Gilg (B, holo.; **BM**, **COL**, **E**, **G**, **K**, **M**, **Z**, iso.). Kubango–Kassinga, 17-5-1900, 1 400 m.

poggei Engl. subsp. **haemantha** Chisumpa & Brummitt

709 Type of *Protea haemantha* Engl. & Gilg (B, holo.; **BM**, **COL**, **E**, **G**, **K**, **M**, **Z**, iso.). Longa, Quiriri, 6-2-1900, 1 275 m.

welwitschii Engl.

653 Type of *Protea melliodora* Engl. & Gilg (B, holo.; **BM**, **COL**, **E**, **G**, **M**, **Z**, iso.). Longa, Minnesera, 11-1-1900, 1 250 m.

903 Type of *Protea myrsinifolia* Engl. & Gilg (B, holo.; **COL**, **G**, **K**, **M**, **S**, **Z**, iso.). Kubango, Menemprem, 8-5-1900, 1 450 m.

RUBIACEAE**CALANDA** K.Schum.**ruhricaulis** K.Schum. var. **ruhricaulis**

899 (B, holo. †; **BR**, **COL**, **K**, **M**, **W**, **Z**, iso.). Menemprem, Kubango (near), 14-5-1900, 1 450 m.

FADOGIA Schweinf.**chlorantha** K.Schum. var. **chlorantha**

482 (B, holo. †; **E**, **W**, **Z**, iso.). Habungu, 28-11-1899, 1 100 m.

chlorantha K.Schum. var. **thamnus** (K.Schum.) Verde.

491 Type of *Fadogia thamnus* K.Schum. (B, holo. †; **BM**, **E**, **K**, **M**, **S**, **W**, **Z**, iso.). Habungu, 22-11-1899, 1 100 m.

chrysantha K.Schum.

210 (B, holo.; **BM**, **M**, **S**, **W**, **Z**, iso.). Kassinga, 4-10-1899, 1 290 m.

GARDENIA Ellis**brachythamnus** (K.Schum.) Launert

389 Type of *Randia brachythamnus* K.Schum. (B, holo. †; **BM**, **COL**, **M**, **W**, **Z**, iso.). Kubango (right bank), Kueio, 5-11-1899, 1 100 m.

LEPTACTINA Hook.f.**pretrophylax** K.Schum.

137 (B, holo. †; **BM**, **E**, **G**, **W**, **Z**, iso.). Chitanda (left bank), 23-9-1899, 1 105 m.

prostrata K.Schum.

713 (B, holo. †; **E**, **G**, **W**, iso.). Quiriri, Sakkemecho, 13-2-1900, 1 300 m.

NEOPENTANISIA Verde.**annua** (K.Schum.) Verde.

659 Type of *Pentania annua* K.Schum. (B, holo. †; **BM**, **K**, **M**, **W**, **Z**, iso.). Longa (left bank), Lazingua, 20-1-1900, 1 250 m.

PAVETTA L.**arenicola** K.Schum.

522 (B, holo. †; **E**, **W**, iso.). Ungombekike–Kuito, 10-12-1899, 1 200 m.

paupercula K.Schum.

805 (B, holo. †; **BM**, **E**, **K**, **W**, **Z**, iso.). Quiriri, Sakkemecho, 9-4-1900, 1 200 m.

stipulopallium K.Schum.

948 (B, holo.; **BM**, **E**, **K**, **M**, **W**, **Z**, iso.). Chitanda (left bank), 28-5-1900, 1 150 m.

RYTIGYNIA Blume**orbicularis** (K.Schum.) Robyns

581 Type of *Plectronia orbicularis* K.Schum. (B, holo.; **BM**, **E**, **K**, **M**, **W**, **Z**, iso.). Longa, Napalanka, 25-12-1899, 1 150 m.

VANGUERIA Juss.**proschii** Briq.

446 Type of *Vangueria lasiocladus* K.Schum. (B, holo.; **COL**, **E**, **K**, **M**, **W**, **Z**, iso.). Kubango (left bank), Kalolo, 20-11-1899.

SANTALACEAE**THESIU** L.**leucanthum** Gilg

218 (B, holo. †?; **COL**, **E**, **K**, **W**, iso.). Kassinga–Kolove, 4-10-1899, 1 300 m.

lycopodioides Gilg

879 (B, holo. †?; **E**, **K**, **W**, iso.). Kulei–Kutsi, 29-4-1900, 1 300 m.

SCROPHULARIACEAE**BAUMIA** Engl. & Gilg**angolensis** Engl. & Gilg

785 (B, holo. †?; **S**, iso.). Onschingue, Kuito (near), 29-3-1900, 1 200 m.

DOPATRIUM Benth.**stachytarphetoides** Engl. & Gilg

923 (B, holo. †?; **COL**, **E**, **M**, **S**, **W**, iso.). Kubango–Kassinga, 17-5-1900, 1 400 m.

LIMNOPHILA R.Br.**ceratophylloides** (Hiern) Skan

750 Type of *Ambulia baumii* Engl. & Gilg (B, holo. †?; **COL**, **K**, **M**, **S**, **W**, **Z**, iso.). Kutue, 2-3-1900, 1 200 m.

dasyantha (Engl. & Gilg) Skan

729 Type of *Ambulia dasyantha* Engl. & Gilg (B, holo. †?; **COL**, **K**, **M**, **S**, **W**, iso.). Quiriri, Sobi, 2-1900, 1 285 m.

SIMAROUBACEAE**KIRKIA** Oliv.**acuminata** Oliv.

966 p.p. quoad fructus, Type of *Kirkia glauca* Engl. & Gilg (B, holo. †?). Makopi–Gambos, 8-6-1900, 1 200 m. Reference: Exell & Mendonça (1951e: 276).

QUASSIA L.

undulata (Guill. & Perr.) D.Dietr.

674 Type of *Hamoa chlorantha* Engl. & Gilg (B, holo. †; *BM, COI, E, G, K, M, S, W, iso.). Longa, Lazingua, 23-1-1900, 1 250 m. Reference: Exell & Mendonça (1951e: 278); Stannard (2000: 11).

STERCULIACEAE

HERMANNIA L.

eenii Baker f.

514 Type of *Hermannia angolensis* K.Schum. (B, holo. †?; *BM, COI, E, G, K, M, S, W, iso.). Ungombekike–Kuito, 9-12-1899, 1 200 m. Reference: Exell & Mendonça (1951f: 195).

STRYCHNACEAE

STRYCHNOS L.

coccuoides Baker

290 Type of *Strychnos schumanniana* Gilg (B, holo. †; BM, E, K, W, Z, iso.). Kubango, Massaca, 19-10-1899, 1 150 m.

THYMELAEACEAE

GNIDIA L.

baumiana Gilg

211 (B, holo. †; COI, M, W, iso.). Chitanda, Kassinga, 4-10-1899, 1 290 m.

pleurocephala Gilg

828 (B, holo. †; W, iso.). Longa, 18-4-1900, 1 275 m.

TILIACEAE

GREWIA L.

avellana Hiern

289 Type of *Grewia perennans* K.Schum. (B, holo. †; G, iso.). Kubango, Massaca, 19-10-1899, 1 150 m. Reference: Exell & Mendonça (1951g: 218).

535 Type of *Grewia hydrophilula* K.Schum. (B, holo. †; *BM, COI, E, G, *K, M, Z, iso.). Kuito (near), 12-12-1899. Reference: Exell & Mendonça (1951g: 218).

falcistipula K.Schum.

353 (B, holo. †; COI, E, G, K, M, S, W, Z, iso.). Kubango (right bank), Kucio, 1-11-1899, 1 300 m. Reference: Exell & Mendonça (1951g: 216).

schinzii K.Schum.

420 Type of *Grewia pinacostigma* K.Schum. (B, holo. †; BM, E, G, W, iso.). Kubango (left bank), Kavanga, 18-11-1899, 1 100 m. Reference: Exell & Mendonça (1951g: 217).

suffruticosa K.Schum.

189 Type of *Grewia brevicaulis* K.Schum. (B, holo. †; *BM, COI, E, G, *K, M, S, Z, iso.). Goudkopje–Kakele, 3-10-1899, 1 210 m. Reference: Exell & Mendonça (1951g: 224).

VERBENACEAE

LIPPIA L.

baumii Gürke var. **baumii**

515 (B, holo. †; *BM, COI, G, K, M, W, iso.). Ungombekike–Kuito, 9-12-1899, 1 200 m. Reference: Verdcourt (1992: 32).

VITACEAE

AMPELOCISSUS Planch.

brunneo-rubra Gilg

509 (B, holo. †; *BM, COI, G, K, W, iso.). Ungombekike, 5-12-1899, 1 200 m. Reference: Exell & Mendonça (1954c: 38).

CISSUS L.

jatrophioides (Welw. ex Baker) Planch.

278 Type of *Cissus chlorantha* Gilg (B, holo. †; G, W, iso.). Kubango, Chirumbu, 14-10-1899, 1 200 m.

CYPHOSTEMMA (Planch) Alston

chloroleucum (Welw. ex Baker) Desc. ex Wild & R.B.Drumm.

361 Type of *Cissus hypargyrea* Gilg (B, holo. †; *BM, COI, G, *K, W, iso.). Kubango (left bank), Kabindere, 2-11-1899, 1 150 m. Reference: Exell & Mendonça (1954c: 60).

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174 (B, holo. †; *BM, COI, G, *K, M, W, iso.). Chitanda (right margin), 27-9-1899, 1 150 m. Reference: Exell & Mendonça (1954c: 58).

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270 (B, lecto., designated by Exell & Mendonça (1954c: 56)†; *BM, COI, G, *K, M, S, isolecto.). Kubango, Chirumbu, 11-10-1899, 1 200 m. Note: Exell & Mendonça (1954c) cited the two syntypes but only 270 is referred to as 'type'. This is considered a lectotypification.

276a (B, syn. †). Kubango, Chirumbu, 10-1899, 1 200 m. Reference: Exell & Mendonça (1954c: 56).

XYRIDACEAE

XYRIS L.

congensis Blütnner

333 Type of *Xyris baumii* L.A.Nilsson (B, holo.; BM, BR, K, M, iso.). Kuebe and Kubango (confl.), 28-10-1899, 1 150 m.

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872 *Adenodolichos rhomboideus* (O.Hoffm.) Harms var. rhomboideus
875 *Buehnera prorepens* Engl. & Gilg
877 *Anisopappus ehinensis* Hook. & Arn. subsp. ehinensis var. ehinensis
879 *Thesium lyeopodioides* Gilg
881 *Gladiolus pallidus* Baker
883 *Bidens baumii* (O.Hoffm.) Sherff
888 *Monotes dasyanthus* Gilg
891 *Aloe metallica* Engl. & Gilg
892 *Ozoroa argyrochrysa* (Engl. & Gilg) R.Fern. & A.Fern.
894 *Cephalaria retrosetosa* Engl. & Gilg
898 *Gladiolus pallidus* Baker
899 *Calanda rubricaulis* K.Schum. var. rubricaulis
903 *Protea welwitschii* Engl.
904 *Ledermannia warmingiana* (Gilg) C.Cusset
906 *Anagallis filifolia* Engl. & Gilg
907 *Emilia limosa* (O.Hoffm.) C.Jeffrey
909 *Hypericum lalandii* Choisy
910 *Benguellia lanceolata* (Gürke) G.Taylor
911 *Polygala rivularis* Gürke
912 *Faurea intermedia* Engl. & Gilg
915 *Floseopa flavida* C.B.Clark
918 *Protea lemairei* De Wild. subsp. trichophylla (Engl. & Gilg) Beard
920 *Protea angolensis* Welw. var. divaricata (Engl. & Gilg) Beard
923 *Dopatrium stachytarphetoides* Engl. & Gilg
926 *Dieoma antunesii* O.Hoffm.
929, 929a *Vernonia temnolepis* O.Hoffm.
933 *Dieoma anomala* Sond. subsp. anomala
938 *Kalanehoe braehyloba* Welw. ex Britten
941 *Ozoroa argyrochrysa* (Engl. & Gilg) R.Fern. & A.Fern.
942 *Duosperma sessilifolium* (Lindau) Brummitt
945 *Diospyros kirkii* Hiern
947 *Combretum molle* R.Br. ex G.Don
948 *Pavetta stipulopallium* K.Schum.
962 *Ottelia kuenensis* (Gürke) Dandy
963 *Commelina subulata* Roth
966 p.p. *quoad fructus* *Kirkia acuminata* Oliv.
981 *Combretum eollinum* Fresen.
982 *Combretum aureonitens* Engl. & Gilg
983, 986 *Combretum eollinum* Fresen.
999 *Boscia welwitschii* Gilg
1005a *Rhynchosia luteola* (Hiern) K.Schum.

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Original name in Warburg (1903)	Portuguese names on maps consulted	S	E	Source*	Notes
Alixandre	Fazenda do Alexandre; Alexandre	15.52 (15.48)	12.09 (12.06)	[4] Sheet no. 3; [5] Sheet no. 1	
Andara	Andara	18.03	21.25	[2]	
Bindi	Lagoa Bindi	17.05	18.40	[2]	
Buraeo	Buraeo	15.35 (15.37)	12.12 (12.11)	[2]; [5] Sheet no. 1	
Cabindere	Cavindera; Cabindele	15.50 (15.52)	17.36 (17.35)	[2]; [3] Sheet no. 385	
Cacimba	Cacimba	15.32	12.02	[5] Sheet no. 1	
Camelungu	Lagoa Camelungu	16.58	18.44	[2]	
Canongofiepfanne	Lagoa Canangossi	16.01	15.24	[5] Sheet no. 2	This lake has apparently disappeared as it is not shown on recent maps examined. Baum's itinerary follows paths marked on map [5].
Carvalhao	Lagoa do Carvalhão	15.45	12.06	[3] Sheet no. 374	
Chibia	Chibia; Vila João de Almeida	15.11	13.42	[3] Sheet no. 356; [2]; [5]	
Chihinde	Chindinde	16.32	14.05	[3] Sheet no. 421	

* Publications and maps consulted:
[1] Warburg, O. 1903. *Kuene-Sambesi-Expedition*. H. Baum. Kolonial-Wirtschaftliches Komitee, Berlin.
[2] Carta da Colónia de Angola (Esboço), Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1935. Esc. 1: 1.500.000.
[3] Carta de Angola, Ministério do Ultramar, Junta das Missões Geográficas e de investigações Coloniais. Esc. 1: 100.000.
[4] Carta da Colónia de Angola, Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1947. Esc. 1: 2.000.000.
[5] Carta do Sul de Angola, Ministério das Colónias, Comissão de Cartografia. 1929–1932. Esc. 1: 500.000.
[6] Carta dos Districtos de Benguela e Mossamedes, Província de Angola, Comissão de Cartografia. 1895. Esc. 1: 1.000.000.
[7] Carta de Angola, Junta de Investigações do Ultramar. 1973. Esc. 1: 2 000 000.
[8] Angola Gazetteer. USGS.

APPENDIX 1.—Main geographical names cited in Warburg (1903) as collecting localities or shown on map included in book, with corresponding actual name and geographical co-ordinates (cont.)

Original name in Warburg (1903)	Portuguese names on maps consulted	S	E	Source*	Notes
Chijija (Chỵỵa on map)	Chicungo	15.47	18.38	[3] Sheet no. 387	Location in [1] coincides with Chicungo.
Chitanda	R. Chitanda; R. Calonga			[2]; [3]	As Chitanda R. in [2] and Calonga R. in [3].
Cicalele-Calilile	Calalele	15.08	20.18	[2]	
Ediva	Ediva	16.20	14.15	[3] Sheet no. 399; [5] Sheet no. 2; [2]	
Fort Tschimbemba	Chibemba; Chivemba	15.45	14.05	[3] Sheet no. 378; [2]; [5] Sheet no. 2; [4] Sheet no. 3	
Goudkopje		15.19	15.55	[3] Sheet no. 360	Exact location may be near these co-ordinates.
Habungu				[7]	Appears to be Chissombo R.
Hadjon Longa (3 dots N on map)		16.06	19.07	[3] Sheet no. 409	There is no indication of settlement in this location. Co-ordinates given here represent a medium location between Palai R. (Palé) and Cuma R. (Mocuma).
Hadjon Longa (3 dots S on map)		16.15	19.07	[3] Sheet no. 409	Co-ordinates given here represent a medium location between Cuma R. (Mocuma) and Cacito R. (Cafito), on left bank of Cuito R.
Hai	Hae; Haii	15.27	13.50	[5] Sheet no. 2; [3] Sheet no. 356; [2]	
Hartebeestpfanne		16.04	15.27	[5] Sheet no. 2; [3] Sheet no. 401	These may be three lakes that have been mapped with the name Etalas Camunhandi. Co-ordinates are those given on map [5].
Humbe	Humbe	16.41	14.54	[3] Sheet no. 422; [4] Sheet no. 3; [2]; [5]	
Jai	Jai	14.42	17.38	[3] Sheet no. 344	
Kafa	Cafu; Cáfú	16.27	15.07	[3] Sheet no. 401; [5] Sheet no. 2; [4] Sheet no. 3; [2]	Co-ordinates correspond to a location on left bank and not to place named Cafu (Cáfú) on map.
Kahama	Cahama	15.17	14.18	[3] Sheet no. 399; [2]; [5] Sheet no. 2; [4] Sheet no. 3	
Kakele	Calima	15.14	16.02	[3] Sheet no. 361	
Kakulovar	R. Caculuvar			[7]	
Kalolo	Calola	17.08	18.14	[3] Sheet no. 452	
Kamba	Pecuária da Camba; Embala da Camba; Camba	16.16	15.15	[3] Sheet no. 401; [5] Sheet no. 2; [2]; [4] Sheet no. 3	
Kampuluve	R. Cumpulua			[7]	
Kanjundu	Caiundo	15.42	17.27	[3] Sheet no. 384; [5] Sheet no. 2; [2]; [4] Sheet no. 3; [6]	
Kapengombe	Capangombe	15.07 (15.06)	13.07 (13.08)	[5] Sheet no. 1; [2]; [3] Sheet no. 355	
Kassinga	Cassinga	15.07	16.05	[3] Sheet no. 361; [2]; [5] Sheet no. 2; [4] Sheet no. 3	
Katholische Mission (Kassinga)	Missão Católica de Cassinga	15.06	16.05	[6] Sheet no. 3	On this map, the mission appears mapped south of Cassinga, not north as it appears on [1].
Katumba	Catomba	15.20	13.37	[3] Sheet no. 356	
Kavumba		15.31	19.15	[3] Sheet no. 367	No village could be located. Co-ordinates correspond to a location near source of Chiova R. (Vijowa).
Kawanga	Cabanga	17.04	18.10	[2]	
Kingu	Quengue?	16.36	15.07	[6] Sheet no. 3	

* Publications and maps consulted:

[1] Warburg, O. 1903. *Kunene-Sambesi-Expedition*. H. Baum. Kolonial-Wirtschaftliches Komitee, Berlin.
[2] Carta da Colónia de Angola (Esboço), Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1935. Esc. 1: 1.500.000.
[3] Carta de Angola, Ministério do Ultramar, Junta das Missões Geográficas e de investigações Coloniais. Esc. 1: 100.000.
[4] Carta da Colónia de Angola, Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1947. Esc. 1: 2.000.000.
[5] Carta do Sul de Angola, Ministério das Colónias, Comissão de Cartografia. 1929–1932. Esc. 1: 500.000.
[6] Carta dos Districtos de Benguela e Mossamedes, Província de Angola, Comissão de Cartografia. 1895. Esc. 1: 1.000.000.
[7] Carta de Angola, Junta de Investigações do Ultramar. 1973. Esc. 1: 2 000 000.
[8] Angola Gazetteer. USGS.

APPENDIX 1.—Main geographical names cited in Warburg (1903) as collecting localities or shown on map included in book, with corresponding actual name and geographical co-ordinates (cont.)

Original name in Warburg (1903)	Portuguese names on maps resources	S	E	Source*	Notes
Kiteve	Quiteve; Chiteve	16.01	15.11	[3] Sheet no. 401; [2]; [5] Sheet no. 2; [4] Sheet no. 3	
Kohi	Vila da Ponte; Vila Artur de Paiva	14.28	16.18	[3] Sheet no. 321; [2]; [5] Sheet no. 2; [4] Sheet no. 3	As Vila da Ponte on [2] and Vila Artur de Paiva on [3] Sheet no. 321.
Konjongo	Caiongo	15.33	19.50	[2]	
Kubango	R. Cubango			[7]	
Kuebe	R. Cuebe			[7]	
Kueio	R. Cueio			[7]	
Kuelleis	R. Colui?			[7]	
Kuimara		17.36	18.37	[3] Sheet no. 463; [2]; [5] Sheet no. 2; [4] Sheet no. 3	This name could not be found but it appears to correspond to Cuangar, since Habungu R. [1] appears to be Bungo R. or Puca R. [2] and Chis-sombo [7].
Kuito	R. Cuito			[7]	
Kulei	R. Cuelel			[7]	
Kunene	R. Cunene			[7]	
Kusisi	R. Cuzizi			[7]	
Kutsi	R. Cuchi			[7]	
Lazingua	R. Luassingua			[7]	
Lihurna ("Destroyed by Kuangaris")		15.12	19.23	[3] Sheet no. 367	Co-ordinates are for Sampuloto, which corresponds to the point given on [1].
Likise (Agent C.D.M.)		15.29	19.38	[3] Sheet no. 368	Co-ordinates refer to an unnamed native village which is located in same place as this name on [1].
Lupembe	Lupembe	16.39	14.52	[5] Sheet no. 2	
Makopi	Macope	15.54	14.09	[6] Sheet no. 3	
Makuju	Macujo; Lagoa Macon-guele	16.26 (16.57)	18.47 (18.50)	[2]; [3] Sheet no. 430	Even though the latitude of this lake is different from that on [1], there are no other lakes mapped in the area.
Manonge	Serpa Pinto; Menongue	14.39	17.41	[3] Sheet no. 344; [2]; [4] Sheet no. 3	
Manonge 1		14.42	17.39	[3] Sheet no. 344	Near Tucuve R. On [3] Sheet no. 344 corresponds to Muanangombe.
Maschonge	R. Massongue			[7]	
Massaca	Massaca	15.35	17.24	[4] Sheet no. 3; [2]	
Matonga	Matonga; Malonga	15.30	20.17	[2]; [4] Sheet no. 6	This locality is east of Ngombé R., whereas on [1] it appears west of that river (Ongombe R.). Taking into account the tracks mapped on [2] which Baum most probably followed, we suppose this is the same Matonga.
Matukua	Mutucua	16.28	14.35	[5] Sheet no. 2	
Menempremp		14.42	16.36	[3] Sheet no. 342	There is a Mema Grande R., south of Vulumba R., that is also a tributary of Cubango R. Co-ordinates given here are those of the confluence of Mema Grande-Cubango Rivers.
Meschekke	Área de Muchequecheque	15.36	13.47	[3] Sheet no. 377	Co-ordinates of Tomba vil-lage, which is located in Muchequecheque area.
Minjanja (Norte)		15.35	19.41	[3] Sheet no. 389	Location of an unnamed village, based on the point mapped on [1].

* Publications and maps consulted:

[1] Warburg, O. 1903. *Kunene-Sambesi-Expedition*. H. Baum. Kolonial-Wirtschaftliches Komitee, Berlin.

[2] Carta da Colónia de Angola (Esboço), Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1935. Esc. 1: 1.500.000.

[3] Carta de Angola, Ministério do Ultramar, Junta das Missões Geográficas e de investigações Coloniais. Esc. 1: 100.000.

[4] Carta da Colónia de Angola, Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1947. Esc. 1: 2.000.000.

[5] Carta do Sul de Angola, Ministério das Colónias, Comissão de Cartografia. 1929–1932. Esc. 1: 500.000.

[6] Carta dos Districtos de Benguela e Mossamedes, Província de Angola, Comissão de Cartografia. 1895. Esc. 1: 1.000.000.

[7] Carta de Angola, Junta de Investigações do Ultramar. 1973. Esc. 1: 2 000 000.

[8] Angola Gazetteer. USGS.

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Original name in Warburg (1903)	Portuguese names on maps consulted	S	E	Source*	Notes
Minjanja (Sul)		15.37	19.44	[3] Sheet no. 389	Location of the Mucoboto village, based on the point mapped on [1]. Not listed in sources searched, it is situated at confluence of Longa and Cuiriri Rivers [1].
Minnesera				[7]	
Mitjelaga	Michelaga	15.14	20.18	[2]	
Mossamedes	Moçâmedes; Mossamedes; Mossâmedes	15.12	12.09	[3] Sheet no. 353; [2]; [5]; [4] Sheet no. 3	There is no village with this name. Co-ordinates refer to an approximate location considering the course of the rivers mapped on [1].
Mukuma	Mucuma	15.00	13.34	[3] Sheet no. 356; [2]; [5]	
Mundongo	Indungo	14.49	16.16	[3] Sheet no. 341; [2]; [4] Sheet no. 3; [5] Sheet no. 2	
Nambali	R. Bale			[7]	Taking into account the course of the rivers on [1], these co-ordinates correspond to approximate location of an unnamed village. Tributary of Cuito R., south of Campulua [1].
Napalanka		16.15	18.52	[3] Sheet no. 408	
Nevis	Neves	15.07	12.54	[5] Sheet no. 1; [2]	
Ondongi-Liwingi	Ondongi	15.23	20.17	[2]	Taking into account the course of the rivers on [1], these co-ordinates correspond to approximate location of an unnamed village. Tributary of Cuito R., south of Campulua [1].
Onjimba		16.36	19.05	[3] Sheet no. 431	
Onschingue					
Otjenjau	Otchinjau	16.30	13.55	[3] Sheet no. 420; [2]; [5] Sheet no. 2; [4] Sheet no. 3	Co-ordinates are for Masseca, in the Micango area. This is based on the actual track [2] which Baum may have followed.
Otjicutsie	Chicusse; Tchicusse	16.22	14.27	[3] Sheet no. 399; [2]; [5] Sheet no. 2; [4] Sheet no. 3	
Palmfontein	Oncócuá; Ongogoa; Fonte das Palmeiras; Uncocua	16.39	13.25	[3] Sheet no. 419; [2]; [5]; [4] Sheet no. 3	
Petri Grande	Pedra Grande	15.00	12.36	[5] Sheet no. 1; [2]	Co-ordinates refer to confluence of Vulumba and Cubango Rivers.
Pokolo	Pocolo	16.24	15.14	[3] Sheet no. 401; [5] Sheet no. 2	
Port Alexandre	Porto Alexandre	15.48	11.51	[3] Sheet no. 373; [2]; [5]	
Quatiri	R. Cuatir			[7]	Co-ordinates refer to confluence of Vulumba and Cubango Rivers.
Quiriri	R. Cuiriri			[7]	
Sakkemecho		14.42	18.39	[3] Sheet no. 346	
Sambento do Sul	São Bento do Sul	15.48 (15.49)	12.06 (12.06)	[2]; [5] Sheet no. 1	Co-ordinates refer to confluence of Vulumba and Cubango Rivers.
Subida	Subida	15.22	12.08	[5] Sheet no. 1	
Tjimbanda	Chimbanda	14.59	20.18	[2]	
Tjipelongo	Tchipelongo; Chipelongo	16.29	14.37	[3] Sheet no. 400; [4] Sheet no. 3; [2]; [5] Sheet no. 2	Co-ordinates refer to confluence of Vulumba and Cubango Rivers.
Tondiva	Tuandiva	16.33	14.44	[3] Sheet no. 422; [5] Sheet no. 2	
Tschiculecandi	Lagoa Chiculecondi	16.53	18.46	[2]	
Umpupe	Ompupa; Umpupa	16.16	13.29	[3] Sheet no. 397; [2]; [5]	Co-ordinates refer to confluence of Vulumba and Cubango Rivers.
Wolombo		14.39	16.31	[3] Sheet no. 342	

* Publications and maps consulted:
[1] Warburg, O. 1903. *Kunene-Sambesi-Expedition*. H. Baum. Kolonial-Wirtschaftliches Komitee, Berlin.
[2] Carta da Colónia de Angola (Esboço), Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1935. Esc. 1: 1.500.000.
[3] Carta de Angola, Ministério do Ultramar, Junta das Missões Geográficas e de investigações Coloniais. Esc. 1: 100.000.
[4] Carta da Colónia de Angola, Ministério das Colónias, Junta das Missões Geográficas e de investigações Coloniais. 1947. Esc. 1: 2.000.000.
[5] Carta do Sul de Angola, Ministério das Colónias, Comissão de Cartografia. 1929–1932. Esc. 1: 500.000.
[6] Carta dos Districtos de Benguela e Mossamedes, Província de Angola, Comissão de Cartografia. 1895. Esc. 1: 1.000.000.
[7] Carta de Angola, Junta de Investigações do Ultramar. 1973. Esc. 1: 2 000 000.
[8] Angola Gazetteer. USGS.

New records of pteridophytes from Annobón Island

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Keywords: Annobón Island, collectors, Equatorial Guinea, flora, Pteridophyta

ABSTRACT

Eight new records of pteridophytes are listed for the flora of Annobón (Equatorial Guinea). Specimen information is provided for 12 literature-based records in the *Flora de Guinea Ecuatorial*. An account of pteridophyte collecting on the island is provided. Pteridophyte diversity in Annobón is updated to 49 species.

INTRODUCTION

The pteridophytes of Equatorial Guinea were recently revised for the *Flora de Guinea Ecuatorial* (Velayos *et al.* 2008). In the introduction of that work, 36 species (Velayos *et al.* 2008: xi) are recorded for the island of Annobón (Gulf of Guinea). However, in the text of the Flora, 41 species are recorded as present in Annobón, 23 of these being specimen-based and 18 based on literature citations. These figures differ from our own unpublished data on the pteridophytes of that island. Our data were compiled on our previous research on the pteridophyte flora of the islands in the Gulf of Guinea (Figueiredo 1998, 2000, 2001, 2002; Figueiredo & Gascoigne 2001) and after the second author participated in the Annobón 2000 Expedition when several more collections of these plants were made. A comparison of both data sets revealed additional records and confirmed records that lacked specimen citation (Table 1) in Velayos *et al.* (2008).

MATERIAL AND METHODS

Two little-known collection sets from Annobón were examined during this work: the collections of Bernard Descoings, kept at the Université de Montpellier (MPU) (examined by the first author) and the Melville/Wrigley collection, kept at the Natural History Museum (BM) in London (examined by the second author). We also had access to an unpublished list of the Melville/Wrigley collections determined by J.A. Crabbe. These collections were not examined by Velayos *et al.* (2008) for the *Flora de Guinea Ecuatorial*.

In this paper we list eight new records for the flora of Annobón and provide specimen information for 12 of 18 literature-based records in Velayos *et al.* (2008), bringing the number of pteridophytes currently known for the island to 49 species (Table 1). The nomenclature follows Roux (2009). Forty collections are cited. The list of new

records and confirmed occurrences is given in alphabetical order. The names of the actual localities (Instituto Geográfico Nacional de España 1982) are given in square brackets. An account of botanical collecting on the island is presented. Herbarium acronyms follow Holmgren & Holmgren (1998).

COLLECTORS ON ANNOBÓN

The island of Annobón is situated in the Gulf of Guinea, \pm 400 km from Gabon. It has a surface area of only 17 km². Due to the remoteness of the island, it is rarely visited and botanical exploration on Annobón has thus been limited when compared with the other Gulf of Guinea islands (Bioko, Príncipe and São Tomé). Exell (1944) gives an account of the first plant collections made on the island by Andrew B. Currer who visited it some time between 1839 and 1842 but only collected two specimens of flowering plants. Between 1861 and 1864, Richard Burton, then the British Consul in Bioko, collected on the island but again neglected the pteridophytes.

The first collections of ferns were made by the Portuguese explorer Francisco Newton who spent three months on the island from November 1892 to January 1893. Newton was employed as an official collector of the Portuguese government and was the first to collect much of the fauna of Príncipe, São Tomé and Annobón but his botanical collections are of less importance (Sobrinho 1953). Six fern species were collected by Newton: *Adiantum mettenii*, *Asplenium africanum*, *Dicranopteris linearis*, *Microgramma mauritiana*, *Ophioglossum reticulatum* and *Pellaea doniana*. Newton's collections were deposited at the University of Lisbon Herbarium (LISU) and treated by Sobrinho (1953). Newton returned to Annobón later in 1893, but this visit lasted no more than one day and he was unable to make any further collections.

The most important botanical collections were made by Gottfried Wilhelm Johannes Mildbraed who spent over a month on the island from 5 September to 13 October 1911 at the end of the Duke of Mecklenburg's second German Central Africa Expedition. Mildbraed collected 32 pteridophyte species, and made detailed notes on the island's vegetation (Exell 1944). Alston (1944) examined some of Mildbraed's collections.

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TABLE 1.—List of pteridophytes recorded on Annobón Island

Taxon	Notes
<i>Abrodictyum rigidum</i> (Sw.) Ebihara & Dubuisson	Literature-based
<i>Adiantum mettenii</i> Kuhn	Literature-based
<i>Alsophila manniana</i> (Hook.) R.M.Tryon	Confirmed
<i>Arthropteris orientalis</i> (J.F.Gmel.) Posth.	-
<i>Asplenium africanum</i> Desv.	-
<i>Asplenium anisophyllum</i> Kunze	-
<i>Asplenium annobonense</i> Viane	-
<i>Asplenium nigritianum</i> Hook.	-
<i>Asplenium sandersonii</i> Hook.	-
<i>Asplenium variabile</i> Hook.	New record
<i>Blechnum attenuatum</i> (Sw.) Mett.	Confirmed
<i>Christella dentata</i> (Forssk.) Brownsey & Jermy	-
<i>Cochlidium serrulatum</i> (Sw.) L.E.Bishop	Confirmed
<i>Crepidomanes africanum</i> (H.Christ) Ebihara & Dubuisson	Literature-based
<i>Crepidomanes melanotrichum</i> (Schltdl.) J.P.Roux	Confirmed
<i>Crepidomanes mettenii</i> (C.Chr.) Ebihara & Dubuisson	Confirmed
<i>Cyclosorus striatus</i> (Schumach.) Ching	New record
<i>Davallia chaerophylloides</i> (Poir.) Steud.	Confirmed
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	-
<i>Didymoglossum erosum</i> (Willd.) J.P.Roux	Literature-based
<i>Diplazium proliferum</i> (Lam.) Kaulf.	-
<i>Dryopteris aurantiaca</i> J.P.Roux	-
<i>Huperzia ophioglossoides</i> (Lam.) Rothm.	Literature-based
<i>Hymenophyllum hirsutum</i> (L.) Sw.	Confirmed
<i>Hymenophyllum kuhnii</i> C.Chr.	-
<i>Lepisorus excavatus</i> (Bory ex Willd.) Ching	-
<i>Loxogramme abyssinica</i> (Baker) M.G.Price	-
<i>Lycopodiella cernua</i> (L.) Pic.Serm.	-
<i>Marattia fraxinea</i> Sm.	-
<i>Microgramma mauritiana</i> (Willd.) Tardieu	-
<i>Microlepis speluncae</i> (L.) T.Moore	New record
<i>Microsorium punctatum</i> (L.) Copel.	Confirmed
<i>Nephrolepis biserrata</i> (Sw.) Schott	-
<i>Nephrolepis undulata</i> (Afzel. ex Sw.) J.Sm.	New record
<i>Oleandra annettii</i> Tardieu	New record
<i>Oleandra distenta</i> Kunze	Confirmed
<i>Ophioglossum reticulatum</i> L.	Confirmed
<i>Pellaea doniana</i> J.Sm. ex Hook.	-
<i>Pityrogramma calomelanos</i> (L.) Link	-
<i>Pneumatopteris oppositifolia</i> (Hook.) Holttum	-
<i>Pneumatopteris venulosa</i> (Kuntze) Holttum	Confirmed
<i>Psilotum nudum</i> (L.) P.Beauv.	-
<i>Pteris linearis</i> Poir.	New record
<i>Pteris togoensis</i> Hieron.	Confirmed
<i>Tectaria camerooniana</i> (Hook.) Alston	New record
<i>Tectaria fernandensis</i> (Baker) C.Chr.	-
<i>Trichomanes crispiforme</i> Alston	Literature-based
<i>Vittaria guineensis</i> Desv.	-
<i>Vittaria owariensis</i> Fée	New record

The British botanist Arthur Wallis Exell only made a visit of a few hours on 15 February 1933. However, Exell's (1944) contribution to our knowledge of the island's flora cannot be underestimated as his *Catalogue of the vascular plants of S. Tomé (with Príncipe and Annobon)* and his later additions to this work (Exell 1956, 1959; Exell & Rozeira 1958) have remained the most important botanical references on the Gulf of Guinea islands.

In 1956, Rose and Denizot (first names unrecorded) of the Muséum National d'Histoire Naturelle in Paris visited the island as part of a multidisciplinary team on board the research vessel the *Calypso*. It is unfortunate that their results have not been published and we were unable to study their collections for this work.

The most significant biological expedition since that of Mildbraed was made in 1959 by a joint Spanish-British expedition, which included the botanists Thomas Christopher Wrigley and Fenella Ann Melville (later Mrs Wrigley). They stayed on the island from July to August that year (Exell 1963). Although Exell (1963) studied some, but not all, of their spermatophyte specimens, their pteridophyte collections have never been studied until now. These collections are housed in the herbarium of the Natural History Museum, London (BM) but have never been incorporated into the main collection. They were determined in an unpublished list by J.A. Crabbe (1960).

The botanist Bernard Descoings visited Annobón in 1964 and made several collections that are deposited at the Montpellier Herbarium (MPU). He arrived at Annobón by boat, from Pointe Noire, as part of an expedition with several researchers. During his stay on the island, which lasted from 24 February to 3 March 1964, he collected 233 numbers (12730–12963). Fifty-six of these collection numbers are pteridophytes and they were examined by the first author at MPU.

In 1987, a Spanish expedition including the botanist Manuel Fidalgo de Carvalho, financed by Cooperacion Espanhola and led by the Asociacion Amigos de Doñana, visited the island. The specimens collected are kept at Real Jardín Botánico (MA), Madrid.

In October 2000, the second author visited the island for nine days as part of the multidisciplinary Annobón 2000 Expedition constituted of a British, Equatorial Guinean and Spanish team. Botanical collections were made by Crissantos Obama of the Equatorial Guinea National Herbarium and Angus Gascoigne; the pteridophyte specimens of the latter are housed in the Centro de Botánica (LISC) in Lisbon.

LIST OF TAXA

(+ = new record; ! = confirmed record)

! *Alsophila manniana* (Hook.) R.M.Tryon

ANNOBÓN: s.l., ± 500 m, 03-03-1964, *Descoings 12958* (MPU); towards top of Surcado [Macizo Santa Mina], 1900 ft [579 m], forming a closed community of its own, 02-08-1959, *Wrigley 226* (BM).

Note: this species is apparently limited to the very top of Macizo Santa Mina, the highest peak on the island (695 m), as it was not observed on the second highest, Pico Quioveo (598 m).

+ *Asplenium variabile* Hook.

ANNOBÓN: SW of Crater Lake [Lago A Pot], under forest, on floor, some below other ferns, 1500 ft [457 m], plantlets at tips of some leaves in shade, 29-07-1959, *Melville* 198 (BM).

Distribution: Angola, Bioko, Cameroon, Central African Republic, Côte d'Ivoire, DRC, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Madagascar, Principe, São Tomé, Sierra Leone, Sudan, Tanzania, Uganda (Roux 2009).

Note: J.A. Crabbe (1960) described this specimen as belonging to the *Asplenium variabile* complex and noted 'the most decompound example I have seen; possibly warranting new specific rank'.

! *Blechnum attenuatum* (Sw.) Mett.

ANNOBÓN: summit section of Macizo Santa Mina, above 500 m, 03-03-1964, *Descoings* 12954 (MPU).

Note: *Wrigley/Melville* 268 cited in J.A. Crabbe's list of specimens from the 1959 expedition (Crabbe 1960) is no longer in the same box as the other specimens. A handwritten note on the box states '*Blechnum* removed TCC 10/77', referring to T.C. Chambers. The specimen could also not be found in the Natural History Museum Herbarium's main *Blechnum* collection.

! *Cochlidium serrulatum* (Sw.) L.E.Bishop

ANNOBÓN: summit section of Macizo Santa Mina, above 500 m, 03-03-1964, *Descoings* 12963 (MPU); Pico del Centro, (also on top of Surcado), epiphyte on 236, 2050 ft [625 m], small acrosticoid fern, grey-green colour, 05-08-1959, *Wrigley* 237 (BM).

Note: Exell (1963) does not cite *Wrigley* 236 (on which 237 was an epiphyte) and the present authors have not located the specimen at BM.

! *Crepidomanes melanotrichum* (Schltdl.) J.P.Roux

ANNOBÓN: Monte del Centro, W face, 400–600 m, 27-02-1964, *Descoings* 12879b (MPU).

! *Crepidomanes mettenii* (C.Chr.) Ebihara & Dubuisson

ANNOBÓN: Monte del Centro, W face, 400–600 m, 27-02-1964, *Descoings* 12888 (MPU).

+ *Cyclosorus striatus* (Schumach.) Ching

ANNOBÓN: round Crater Lake, marshy ground extending into the water, 885 ft [270 m], *Wrigley* 279 (BM).

Distribution: Bioko, Burundi, DRC, Equatorial Guinea, Guinea-Bissau, Liberia, Rwanda, Sierra Leone, Sudan (Roux 2009).

! *Davallia chaerophylloides* (Poir.) Steud.

ANNOBÓN: path from San Antonio del Norte [Palé] to the Crater Lake [Lago A Pot], 100–200 m alt., 25-02-1964, *Descoings* 12830 (MPU); near the Crater Lake [Lago A Pot], ± 280 m, epiphyte in woodland, *Exell* 896 (BM); on path from Anganchi (S. Pedro) to Cus, 50 m, 22-10-2000, observed from 50–480 m in the Anganchi Valley, very common, *Gascoigne* 60 (LISC); NE side of Pico de Fogo, rocky places, just fertile, (rare), 24-07-1959, *Melville* 185 (BM).

Note: in the main entry for *Davallia denticulata* (Burm.f.) Underw. (= *D. chaerophylloides*) in Velayos *et al.* (2008: 41) there is only a literature record for Annobón. However, *Gascoigne* 60 was listed in the index to collections, referring to this species (Velayos *et al.* 2008: 149).

! *Hymenophyllum hirsutum* (L.) Sw.

ANNOBÓN: Monte del Centro, W face, 400–600 m, 27-02-1964, *Descoings* 12879a (MPU); summit section of Macizo Santa Mina, above 500 m, 03-03-1964, *Descoings* 12957b (MPU).

+ *Microlepia speluncae* (L.) T.Moore

ANNOBÓN: Pico Santiago, W of the Crater Lake [Lago A Pot], 200–320 m, 26-02-1964, *Descoings* 12866 (MPU); S shore of Crater Lake [Lago A Pot], under *Elaeis*, 885 ft [270 m], fertile, 2 × pinnate pinnatifid, 31-07-1959, *Wrigley* 225 (BM).

Distribution: Angola, Bioko, Botswana, Burundi, Cameroon, Central African Republic, Comoro Is., Congo, Côte d'Ivoire, DRC, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Madagascar, Malawi, Mozambique, Namibia, Nigeria, Réunion, Rwanda, São Tomé, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe (Roux 2009).

! *Microsorium punctatum* (L.) Copel.

ANNOBÓN: around San Antonio del Norte [Palé], 24-02-1964, *Descoings* 12790 (MPU); path from San Antonio del Norte [Palé] to the Crater Lake [Lago A Pot], 100–200 m, 25-02-1964, *Descoings* 12813 (MPU); SW of Crater Lake, on rocks beneath forest and epiphytic on trees, quite commonly, 1500 ft [457 m], more common than [Melville] 202 [*Asplenium africanum*], forms communities on rocks and trees, 29-07-1959, *Melville* 203 (BM).

Note: although not collected on the Annobón 2000 Expedition, this species was observed as very common at all localities visited, e.g. Anganchi Valley, around Lago A Pot, with the exception of the very highest or driest locations, e.g. slopes of Macizo Santa Mina and Pico Quioveo, and near the town of Palé.

+ *Nephrolepis undulata* (Afzel. ex Sw.) J.Sm.

ANNOBÓN: Pico Santiago, W of the Crater Lake [Lago A Pot], 200–320 m, 26-02-1964, *Descoings* 12863 (MPU); Pico de Fogo, under overhanging rocks, 1200 ft [366 m], simply pinnate, runners with small tubers in soil, 24-07-1959, *Wrigley* 89 (BM).

Distribution: Angola, Benin, Bioko, Burundi, Cameroon, Cape Verde Is., Central African Republic, Comoro Is., Congo, Chad, Côte d'Ivoire, DRC, Eritrea, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Principe, Rwanda, São Tomé, Senegal, Sierra Leone, Socotra, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe (Roux 2009).

+ *Oleandra annettii* Tardieu

ANNOBÓN: Pico Santiago, W of the Crater Lake [Lago A Pot], 200–320 m, 26-02-1964, *Descoings* 12868 (MPU); Monte del Centro, W face, 400–600 m, 27-02-1964, *Descoings* 12900 (MPU); S side of Lago A Pot, 450 m, climbing fern, 25-10-2000, *Gascoigne* 78 (LISC).

Distribution: Bioko, Cameroon, Seychelles (Roux 2009).

Note: *Oleandra annettii* was recorded as absent from Annobón, in Velayos *et al.* (2008: 88). However, in the index to collections, *Gascoigne* 78 was listed, referring to this species (Velayos *et al.* 2008: 149).

! *Oleandra distenta* Kunze

ANNOBÓN: Pico del Centro, rock face, some crescent-shaped, rhizome blue-green, long trailers hanging from bushes over rock face, leaf stalk jointed, with abrasion layer, 01-08-1959, *Melville* 216 (BM).

! *Ophioglossum reticulatum* L.

ANNOBÓN: fields at base of Pico S. Estephania [Pico do Fogo?], 400 m, this species is excessively abundant on the island, *Newton s.n.* (LISU); near Ambo (E), pathside, 100 ft [30 m], very abundant locally but only one locality seen, creeping rhizome when young, 17-07-1959, *Wrigley* 47 (BM).

! *Pneumatopteris venulosa* (Kuntze) Holttum

ANNOBÓN: towards Pico Surcado from San Pedro, forest, pinnules tending to overlap the rachis, not often fertile, *Wrigley* 231 (BM).

Note: a duplicate of this collection, *Wrigley* 231 (K), was cited by Velayos *et al.* (2008: 112) under *Pneumatopteris oppositifolia* (Hook.) Holttum. It is possible that one of these specimens is misdetermined. *P. venulosa* was previously recorded in the literature for Annobón, as referenced by Velayos *et al.* (2008: 112).

+ *Pteris linearis* Poir.

ANNOBÓN: path from San Antonio del Norte [Palé] to the Crater Lake [Lago A Pot], 100–200 m, 25-02-1964, *Descoings* 12827 (MPU); Pico Santiago, W of the Crater Lake [Lago A Pot], 200–320 m, 26-02-1964, *Descoings* 12859 (MPU); Ambo, near our houses, rocky bed of rivulet with [Melville] 136 [*Tectaria camerooniana*], 80 ft [24 m], edges of pinnules form sori, 12-07-1959, *Melville* 138 (BM).

Distribution: Bioko, Burundi, Cameroon, Comoro Is., Congo, Côte d'Ivoire, DRC, Equatorial Guinea, Gabon, Ghana, Guinea, Liberia, Madagascar, Mali, Mauritius, Príncipe, Réunion, Rwanda, São Tomé, Sierra Leone, Sudan, Tanzania, Uganda, Zambia, Zimbabwe (Roux 2009).

! *Pteris togoensis Hieron.*

ANNOBÓN: summit section of Macizo Santa Mina, above 500 m, 03-03-1964, *Descoings 12953, 12956* (MPU); on path from Cus to Aual, next to dry stream bed, \pm 150 m, 23-10-2000, *Gascoigne 65* (LISC); Monte Santiago, 350 m, 25-10-2000, *Gascoigne 85* (LISC); rocky outcrop to SSE of Pico do Fogo, rock face, bare, facing west, fertile fern, *Melville 186* (BM).

+ *Tectaria camerooniana* (Hook.) Alston

ANNOBÓN: Ambo, near our houses, waste ground, 80 ft [24 m], sparsely fertile, much of it up in the forest, 12-07-1959, *Melville 136* (BM).

Distribution: Bioko, Cameroon, DRC, Equatorial Guinea (Roux 2009).

+ *Vittaria owariensis Fée*

ANNOBÓN: Pico Santiago, W of the Crater Lake [Lago A Pot], 200–320 m, 26-02-1964, *Descoings 12862* (MPU); Monte del Centro, W face, 400–600 m alt., 27-02-1964, *Descoings 12897* (MPU).

Distribution: Congo, Gabon, Ghana, Liberia, Nigeria, Príncipe, São Tomé (Roux 2009).

Note: the maximum altitude of Monte Santiago, over which the path to Quioveo passes, is 257 m. This is the first record for Equatorial Guinea. Velayos *et al.* (2008: 123) excluded this species for lack of specimens.

Additionally, the occurrence of the genus *Adiantum* on Annobón can be confirmed. The collection *Newton s.n.* (LISU) was cited in the literature (Sobrinho 1953) as *Adiantum mettenii* Kuhn but Velayos *et al.* (2008) report it as not located at LISU. During the Annobón 2000 Expedition, a species of *Adiantum* was encountered and photographed in the Anganchi Valley at S1°26.368' E5°38.649' at approximately 70 m. The photograph does not show sufficient detail to allow positive identification at species level but confirms the presence of the genus on Annobón.

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Notes on African plants

VARIOUS AUTHORS

RANUNCULACEAE

THE GENUS *KNOWLTONIA* SUBSUMED WITHIN *ANEMONE*

The family Ranunculaceae, with $\pm 1\ 750$ species in ± 60 genera, is poorly represented in sub-Saharan Africa (Dreyer & Jordaan 2000; Leistner 2005), and most representatives on the continent are restricted to temperate, often afro-montane habitats. Five genera and just over 40 species are recorded for southern Africa: *Anemone* L. (3 spp.), *Clematis* L. (= *Clematopsis* Boj. ex Hook.) (± 20 spp.), *Delphinium* L. (3 spp.), *Knowltonia* Salisb. (± 8 spp.) and *Ranunculus* L. (± 8 spp.), the majority represented by just a handful of species comprising a small fraction of each genus. *Knowltonia*, endemic to southern and southern tropical Africa (Rasmussen 1979), is the single exception. This biogeographical anomaly raises questions as to the origin of the genus and its relationship to other southern African Ranunculaceae.

The genus *Knowltonia* Salisb. was proposed by Salisbury (1796) for the southern African species of Ranunculaceae previously referred to *Adonis* L., from which it was diagnosed on the basis of its fleshy fruits and broad filaments. It soon became evident, however, that *Knowltonia* was most closely allied to *Anemone* (De Candolle 1817; Bentham & Hooker 1862), with which it shares an involucre of bracts beneath the flowers, and uniovulate carpels with pendent ovules. The genus was subsequently formally included in *Anemone* as section *Knowltonia* by Prantl (1891), followed by Burt Davy (1912). Later South African botanists, misinterpreting the morphology, reinstated it as a separate genus, either mistakenly considering that it lacked an involucre (Hutchinson 1923; Phillips 1951), or because they were misled in thinking that the perianth was double (Dyer 1975). In fact, all species of *Knowltonia* have an involucre beneath the flowers, and the perianth could only possibly be construed as double in a single species, *K. capensis*, in which the outer three or four tepals are shorter and more hairy than the inner (Rasmussen 1979).

The difference between *Anemone* and *Knowltonia* lies essentially in the texture of the fruit wall, which is fleshy in *Knowltonia* and dry in *Anemone*, although the basic structure of the fruit walls in the two genera is similar (Lonay 1901). In *K. vesicatoria* (L.f.) Prantl, the single species that was examined microscopically, the fruit wall comprises more cell layers, and the differentiation into an inner and outer portion is more pronounced than in *Anemone*, but other species of *Knowltonia* with less fleshy fruits have not been examined. In gross morphology there is little to distinguish the two genera. The rhizomatous rootstock, basal leaves, involucre, and simple perianth of *Knowltonia* are all characteristic of *Anemone*, and the branched inflorescence, although more complex than typically found in *Anemone*, is similar in struc-

ture and found in several species, including *A. demissa* Hook. & Thoms. and *A. narcissiflora* L. from the northern hemisphere, and to a lesser degree in *A. fanninii* Harv. ex Mast. from South Africa. The strictly centrifugal dehiscence of the stamens that was taken to characterize *Knowltonia*, is also found in some African species of *Anemone* (Rasmussen 1979), and although no species of *Anemone* has the broad filaments of *Knowltonia*, the connective in some species of *Anemone* is as wide as that of species such as *K. transvaalensis*. This species in particular resembles *Anemone*, and specimens of it have twice formed the basis for names in *Anemone*. The two genera are also closely allied chemically in sharing triterpene saponins (Schneider 1930).

Despite the evident similarities between the two genera, Rasmussen (1979) argued for the continued recognition of *Knowltonia* as distinct from *Anemone* on the basis that the two were as distinct from one another as other genera then recognized within the family. She diagnosed *Knowltonia* by its centrifugally maturing stamens (also known in *Anemone*), broad connectives and filaments, more or less fleshy fruits, and stigmatic papillae covering the whole ventral side of the style.

However, a wider morphological and molecular analysis of 36 species of *Anemone* plus representatives of *Adonis*, *Caltha*, *Clematis*, *Hepatica*, *Knowltonia*, *Pulsatilla* and *Ranunculus*, led Hoot *et al.* (1994) to conclude that *Knowltonia* and *Pulsatilla* should be subsumed within *Anemone*, specifically in sect. *Pulsatilloides* DC. A close relationship between *Knowltonia* and sect. *Pulsatilloides* had been suggested fifty years earlier by Janchen (1949) on biogeographical grounds. The occurrence of centrifugal stamen development in some African members of *Anemone* sect. *Pulsatilloides* and the discovery that they share pantoporate pollen with *Knowltonia* (Van Zinderen Bakker 1956; Huynh 1970) provides additional support for this view. More recent phylogenetic analyses of *Anemone* and related genera using chloroplast and nuclear DNA (Schuettelpelz *et al.* 2002) support sect. *Pulsatilloides* (including *Knowltonia*) as a monophyletic group within *Anemone* subgenus *Anemone*. Within section *Pulsatilloides*, *Knowltonia* is retrieved as sister to the South African species *Anemone caffra*, suggesting that the genus shares an ancestry with one or more of the southern African *Anemone* species.

The continued recognition of the genus *Knowltonia* renders *Anemone* paraphyletic. Furthermore, it not only fails to recognize but actually obscures the intimate relationship between the species of *Knowltonia* and the southern African members of *Anemone* sect. *Pulsatilloides*.

loides. The species of *Knowltonia* are thus most properly interpreted as constituting a lineage within *Anemone* sect. *Pulsatilloides* that has radiated in southern Africa. We accordingly downgrade the genus to a series in *Anemone* section *Pulsatilloides* and make the necessary specific transfers.

TAXONOMY

***Anemone* section *Pulsatilloides* series *Knowltonia* (Salisb.) J.C.Manning & Goldblatt, stat. nov.**

Knowltonia Salisb., Prodrum stirpium in horto ad Chapel Allerton vigintium: 372 (1796). *Anemone* section *Knowltonia* (Salisb.) Prantl: 62 (1891). Type: *Knowltonia rigida* Salisb., nom. illeg. (= *A. knowltonia* Burtt Davy).

1. *Anemone anemonoides* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia anemonoides H.Rasm. in Opera Botanica 53: 18 (1979). Type: South Africa, [Western Cape], Jonkershoek, 7 November 1943, Compton 15342 (NBG, holo.; K, PRE, iso.).

1a. *Anemone anemonoides* subsp. *tenuis* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia anemonoides subsp. *tenuis* H.Rasm. in Opera Botanica 53: 20 (1979). Type: South Africa, [Western Cape], Genadendal, Baviaanskloof, 11 March 1933, Gillett 848 (BOL, holo.; STE, iso.).

2. *Anemone bracteata* (Harv. ex J.Zahlbr.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia bracteata Harv. ex J.Zahlbr. in Annalen des K.K. Naturhistorischen Hofmuseums, Wien: 380 (1903). Type: South Africa, Kaffraria [Eastern Cape], 1860, Cooper 335 [K, lecto., designated by H.Rasm.: 34 (1979); NH, PRE, iso.].

3. *Anemone brevistylis* (Szyszyl.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia brevistylis Szyszyl., Polypetalae thalamiflorae Rehmannianae: 99 (1887). Type: South Africa, [KwaZulu-Natal], Inanda, Rehmann 8395 [Z, lecto., designated by H.Rasm.: 32 (1979); Z, iso.].

4. *Anemone cordata* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia cordata H.Rasm. in Opera Botanica 53: 21 (1979). Type: South Africa, [Western Cape], George, 24 March 1893, Schlechter 2388 (BOL, holo.; GRA, J, MO, iso.).

5. *Anemone filia* (L.f.) J.C.Manning & Goldblatt, comb. nov.

Adonis filia L.f., Supplementum plantarum: 271 (1781). *Knowltonia filia* (L.f.) T.Dur. & Schinz: 12 (1898). Type: South Africa, without precise locality or date, LINN714.9 [LINN, lecto., designated by H.Rasm.: 23 (1979)].

5a. *Anemone filia* subsp. *scaposa* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia filia subsp. *scaposa* H.Rasm. in Opera Botanica 53: 25 (1979). Type: South Africa, [Eastern Cape], Humansdorp, Blaauwkrantz Pass, 16 November 1965, Marve 4436 (PRE, holo., iso.).

6. *Anemone knowltonia* Burtt Davy in Annals of the Transvaal Museum 3: 121 (1912). *Adonis capensis* L.: 548 (1753). *Anemania capensis* (L.) Hoffmanns.: 204 (1824). *Knowltonia capensis* (L.) Huth: 69 (1890), nom. illegit., non *Anemone capensis* Lam. (1783). Type: South Africa, without precise locality or date, LINN714.6 [LINN, lecto., designated by H.Rasm.: 16 (1979)].

Anemania gracilis Vent.: 22 (1803). *Knowltonia gracilis* (Vent.) DC.: 219 (1817), nom. illegit., non *Anemone gracilis* F.Schmidt (1868). Type: South Africa, without precise locality or date, Herb. Jussieu 10575 [P-JU, lecto., designated by H.Rasm.: 16 (1979)].

7. *Anemone vesicatoria* (L.f.) Prantl in Die natürlichen Pflanzenfamilien 3,2: 62 (1891). *Adonis vesicatoria* L.f.: 272 (1781). *Knowltonia vesicatoria* (L.f.) Sims: 775 (1804). Type: South Africa, without precise locality or date, LINN714.8 [LINN, lecto., designated by H.Rasm.: 27 (1979)].

7a. *Anemone vesicatoria* subsp. *humilis* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia vesicatoria subsp. *humilis* H.Rasm. in Opera Botanica 53: 29 (1979). Type: South Africa, [Western Cape], Knysna, 12 November 1949, Morris 380 (NBG, holo.; BOL, STE, iso.).

7b. *Anemone vesicatoria* subsp. *grossa* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia vesicatoria subsp. *grossa* H.Rasm. in Opera Botanica 53: 30 (1979). Type: South Africa, [Western Cape], Knysna, Matjiesrivier Mouth, 16 October 1938, Gillett 4555 (BOL, holo.; K, PRE, iso.).

8. *Anemone transvaalensis* (Szyszyl.) Burtt Davy in Annals of the Transvaal Museum 3: 121 (1912). *Knowltonia transvaalensis* Szyszyl.: 99 (1887). Type: South Africa, [Limpopo], Houtboschberg, 1875, Rehmann 6402 (Z, holo.; K, iso.).

Knowltonia canescens Szyszyl.: 100 (1887), *Anemone canescens* (Szyszyl.) Burtt Davy: 121 (1912). Type: South Africa, [Limpopo], Houtboschberg, 1875, Rehmann s.n. (Z, holo.).

Anemone whyteana Baker f.: 4 (1894). *Knowltonia whyteana* (Baker f.) Engl.: 170 (1915). Type: Malawi, Mt Mulanj, October 1891, Whyte 100 [BM, lecto., designated by Milne-Redhead & Turrill: 13 (1952); BM, K, W, iso.].

Anemone peenensis Baker f.: 16 (1911). Type: Zimbabwe, Gaza-land, Mt Pene, 28 September 1906, Swynnerton 783 [BM, lecto., designated by Milne-Redhead & Turrill: 13 (1952)].

Knowltonia multiflora Burtt Davy: 343 (1921). Type: South Africa, [Mpumalanga], Lydenburg, without date, Mudd s.n. (K, holo.).

8a. *Anemone transvaalensis* var. *filifolia* (H.Rasm.) J.C.Manning & Goldblatt, comb. nov.

Knowltonia transvaalensis var. *filifolia* H.Rasm. in Opera Botanica 53: 38 (1979). Type: South Africa, [Mpumalanga], 7 miles [11 km] east of Belfast, 10 October 1950, Prosser 1510 (NBG, holo.; K, iso.).

8b. *Anemone transvaalensis* var. *pottiana* (Burtt Davy) J.C.Manning & Goldblatt, comb. nov.

Knowltonia canescens var. *pottiana* Burtt Davy in Kew Bulletin 1921: 343 (1921). *Knowltonia transvaalensis* var. *pottiana* (Burtt Davy) H.Rasm.: 39 (1979). Type: South Africa, [Mpumalanga], Dullstroom, June 1920, Noomé, Trans. Mus. Herb. 20803 (K, holo.).

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EUPHORBACEAE

A NEW SPECIES OF SUCCULENT *EUPHORBIA* FROM SOUTHERN ANGOLA

INTRODUCTION

With over 2 000 species and an almost cosmopolitan distribution, *Euphorbia* L. is the second largest genus of flowering plants and is one of the most taxonomically challenging groups. New taxa come to light regularly. In this paper a new species is described from the relatively little-known coastal desert of southern Angola. It belongs to the very widely distributed group of species that make up subg. *Euphorbia* sect. *Tirucalli* Boiss. Species of this section occur mainly in arid to very arid areas, from Dhofar in Oman on the Arabian Peninsula to the Namib Desert of southern Africa.

***Euphorbia chamaeclada* Bruyns, sp. nov.**, a ceteris speciebus sect. *Tirucalli* caulibus patentibus dense ramosisque et parvioribus cyathis capsulisque differt.

TYPE.—Angola, Namibe Dist., 10 km towards Sao Nicolau, 300 m, January 2006, *Bruyns 10402a* (BOL, holo.; E, MO, iso.).

Sprawling, many-branched, unisexual, spineless, succulent shrub up to 0.2 × 0.5–1.5 m, arising from thickened underground stem with fibrous roots. *Branches* ± prostrate, very densely and alternately rebranched towards tips, terete and not articulated at joints, 150–750

× 6–15 mm, ultimate branchlets 20–150 × 3–6 mm, smooth and white-pubescent to tawny-felted near growing tips becoming grey to grey-green with age, tips often dying off later to form slight spikes. *Leaf-rudiments* towards apex of branches, alternate, ovate-lanceolate, 4–10 × 2–4 mm, very slightly fleshy, ascending, usually slightly longitudinally folded upwards, brownish pubescent, with entire margins, acute, tapering below into slightly swollen base but epetiolate, with small dark brown globular stipules on either side at base, caducous. *Inflorescences* terminal on branchlets, finely pubescent, each of 1–6 clustered unisexual cyathia (in groups of 3–6 in males, solitary in females) on short peduncles 1–2 mm long, each subtended by 2–4 small, scale-like, broadly ovate, pubescent, red to brown bracts, 1–2 × 1.5–2.0 mm (often with small irregular brown stipules at base). *Cyathia* obconical (nearly cylindrical in females), finely pubescent, 3 mm diam., ± 2.5 mm long below insertion of glands, with 5 ± semicircular, finely pubescent lobes with deeply incised margins, dull green, finely pubescent outside; *glands* 5, transversely elliptical, 1.5–2.0 mm broad, spreading, yellow-green to reddish green, flat to slightly concave above, widely spaced, outer margin entire, inner margin very slightly raised. *Stamens* with glabrous pedicels, interspersed with filiform to hand-like glabrous bracteoles. *Ovary* nearly spherical, finely

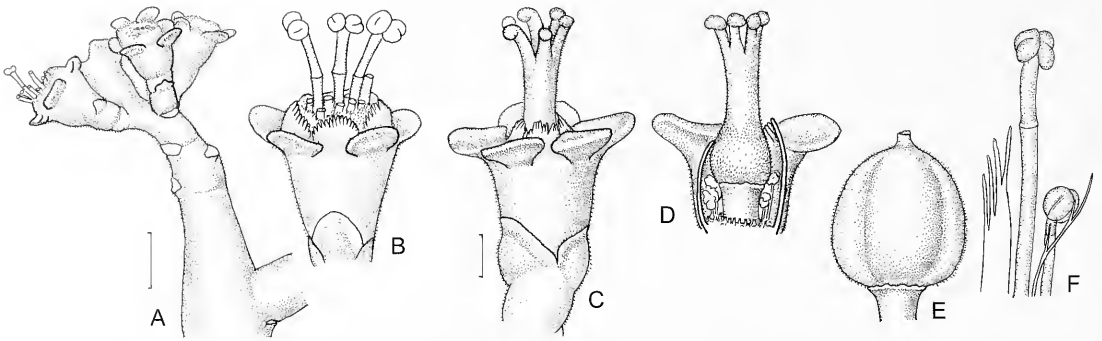


FIGURE 1.—*Euphorbia chamaeclada*, Bruyns 10402a. A, apex of stem with several male cyathia; B, male cyathium; C, female cyathium; D, side view of dissected female cyathium; E, capsule just before dehiscence; F, male florets with bracteoles. Scale bar: A, E, 3 mm (at A); B–D, 1 mm (at C); F, 1 mm (at A). Artist: Peter Bruyns.

pubescent, surrounded by many sterile male florets, raised on stout glabrous pedicel nearly 1 mm long; styles 3 mm long, divided in upper third, initially erect and later becoming horizontally spreading. *Capsule* obtusely 3-angled, 7–8 mm diam., finely pubescent, slightly exserted from cyathium but remaining erect on glabrous pedicel 1–2 mm long, reddish green. *Seeds* ellipsoidal, 3 × 2 mm, smooth, grey, with white apical caruncle. Figure 1.

Euphorbia chamaeclada occurs in southern Angola in the so-called ‘Moçamedes Desert’ to the northeast of Namibe, formerly known as Moçamedes (Figure 2), in gently sloping reddish granitic terrain with isolated low piles of boulders. The vegetation here is sparse and low, mostly not higher than 300 mm, with many lichens hanging from the branches of the more woody shrubs. Succulents achieve a remarkable diversity here. Apart from the new species, these include *Aloe dinteri*, *Euphorbia carunculifera*, *E. indurescens* and *E. subsalsa*, *Kalanchoe scapigera* and a species of *Kleinia*, *Talinum portulacifolium* and various species of *Portulaca*, as well as a wide selection of Apocynaceae, including *Adenium obesum*, *Fockea angustifolia*, *Hoodia currorii*, *H. mossamedensis*, *Huernia lapanthera*, *H. oculata*, *Sarcostemma viminalis*, *Stapelia kwebensis*, *S. parvula* and *Tavaresia angolensis*.

That *Euphorbia chamaeclada* belongs to *Euphorbia* subg. *Euphorbia* sect. *Tirucalli* is clear from several facts. The plants are unisexual with alternate, cylindrical branches and felty tips to the young branches. Growing branches bear pubescent, alternating leaf-rudiments as well as terminal, externally pubescent, unisexual cyathia which are densely clustered in the case of the males and solitary in the case of the females. Section *Tirucalli* is most diverse in Madagascar, with a few widely scattered species found outside Madagascar from Oman and southern Yemen (*E. dhofarensis* S.Carter) to Socotra (*E. arbuscula* Balf.f.) and in mainland Africa from Somalia (*E. bariensis* S.Carter), Mozambique (*E. tirucalli* L.), Angola (four species), Namibia (four species) and South Africa (two species). The six species from Angola to South Africa are all associated with the Namib Desert: *E. gregaria* Marloth and *E. gummifera* Boiss. are found in the southern portion bordering on the winter rainfall region of the Richtersveld and the Orange River (northwestern South Africa and southern Namibia); *E. damarana* L.C.Leach occurs from central Namibia to

the southernmost corner of Angola; *E. carunculifera* L.C.Leach and *E. congestiflora* L.C.Leach are more widespread in southern Angola, with *E. congestiflora* just reaching into northern Namibia. *E. chamaeclada* then brings the number of species in southern Angola to four (together with *E. carunculifera*, *E. congestiflora* and *E. damarana*).

Euphorbia chamaeclada is easily separated from all the others in sect. *Tirucalli* by its lowly, sprawling habit with densely branching stems. In habit, it is by far the smallest known member of the section. In this respect, it is easily separated from *E. carunculifera*, which grows nearby and forms very large shrubs up to 2 m tall with considerably thicker branches. In *E. chamaeclada* the above-ground branches are sometimes eaten right off to the thickened underground stem, from which new growth sprouts again readily. At 3 mm diameter, the

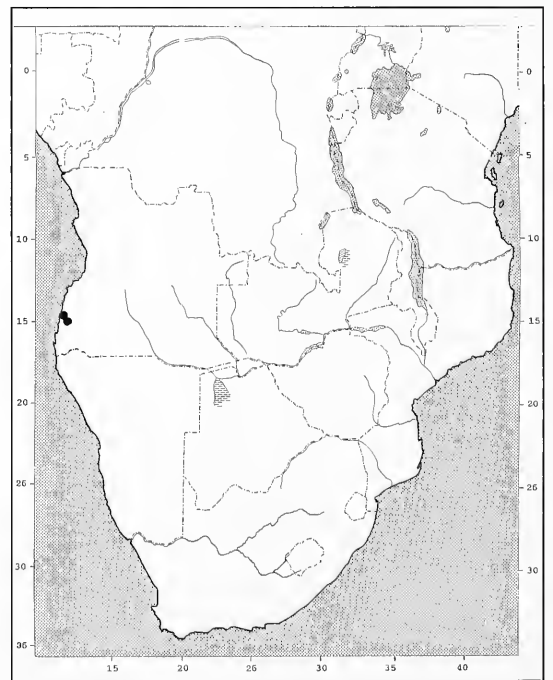


FIGURE 2.—Known distribution of *Euphorbia chamaeclada*.

cyathia (Figure 2) are also much smaller than in any of the other species, since they are 5–6 mm broad in *E. congestiflora* and 4.5 mm broad in *E. carunculifera* (Leach 1970). The capsules are of similar dimensions to those of *E. congestiflora* but are smaller than those of *E. carunculifera* (where the capsules are 10 × 8 mm). In *E. carunculifera* the capsules are bright orange and do not dehisce explosively, rather falling apart on drying out, whereas the capsules in *E. chamaeclada* are reddish green and dehisce explosively when ripe.

In respect of its lowly growth, *Euphorbia chamaeclada* bears far more resemblance vegetatively to the sympatric *E. indurescens* L.C. Leach than to any other member of its section. However, *E. indurescens* is not closely related, being a close relative of *E. lignosa* Marloth and a typical member of subg. *Rhizanthium* (Bruyns *et al.* 2006). In these species the leaves are borne on small phyllopodia, the cyathia are solitary at the tips of the branches and are larger and bisexual, with the cyathial glands toothed along their outer margins.

The name *chamaeclada* is derived from the Greek, *chamae*, creeping and *clada*, branch.

Other material examined

ANGOLA.—Near Chapeu Armado, 480 m, Bruyns 10723 (BOL, K, M).

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HYACINTHACEAE

NOMENCLATURAL CORRECTIONS IN ORNITHOGALOIDEAE

A recent revision of generic circumscriptions in Hyacinthaceae: Ornithogaloideae (Manning *et al.* 2009) resulted in numerous new combinations in the genus *Albuca* L. Four of these combinations were invalidly published because of incomplete reference to the place of publication of the basionym or the replaced synonym (McNeil *et al.* 2006: Art. 33.4). These oversights are corrected here.

Albuca deserticola J.C. Manning & Goldblatt, nom. nov., pro *Ornithogalum etesiogariense* D. Müll.-Doblies & U. Müll.-Doblies in Feddes Repertorium 107: 478 (1996), non *Albuca etesiogariensis* U. Müll.-Doblies (1995).

Albuca deserticola subsp. ***longipilosa*** (U. Müll.-Doblies & D. Müll.-Doblies) J.C. Manning & Goldblatt, comb. nov. *Ornithogalum etesiogariense* subsp. *longipilosa* U. Müll.-Doblies & D. Müll.-Doblies in Feddes Repertorium 107: 478 (1996).

Albuca glandulifera J.C. Manning & Goldblatt, nom. nov., pro *Ornithogalum glandulosum* Oberm. in Bothalia 12: 369 (1978), non *Albuca glandulosa* Baker (1875).

Albuca rautanenii (Schinz) J.C. Manning & Goldblatt, comb. nov. *Ornithogalum rautanenii* Schinz in Bulletin de l'Herbier Boissier, sér. 2, 2: 937 (1902).

In the same publication (Manning *et al.* 2009), the two new tribes Dipcadiaceae J.C. Manning & Goldblatt and Ornithogaleae J.C. Manning & Goldblatt were published. Both of these names were, however, validly published a century ago (Rouy 1910) and the names published by Manning *et al.* (2009) are thus isonyms without nomenclatural status (McNeil *et al.* 2006: Art. 6.N.2.).

Hyacinthaceae tribe **Dipcadiaceae** Rouy, Flore de France 12: 426 (1910). Type: *Dipcadi* Medik.

Dipcadiaceae J.C. Manning & Goldblatt in Manning *et al.*: 98 (2009), isonym.

Hyacinthaceae tribe **Ornithogaleae** Rouy, Flore de France 12: 411 (1910). Type: *Ornithogalum* L.

Ornithogaleae (Caruel) J.C. Manning & Goldblatt in Manning *et al.*: 99 (2009), isonym. Subtribe Ornithogalinae Caruel: 42 (1892).

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MIMOSACEAE

A NEW SPECIES OF *ACACIA* FROM NORTHERN MOZAMBIQUE

INTRODUCTION

In the course of researching a publication on the woody flora of Mozambique, a distinctive undescribed species of *Acacia* was collected south of the coastal town of Pemba in the Cabo Delgado Province of northeastern Mozambique. When first seen, the trees were deciduous and the large broad, blackish stipular spines stood out strikingly, rendering them unmistakable. Although clearly related to *Acacia amythethophylla* Steud. ex A.Rich. (Hunde 1979; Ross 1979; Timberlake *et al.* 1999), it was realised that the combination of morphological and ecological differences justify describing this taxon as a new species, *Acacia latispina*.

Acacia latispina J.E.Burrows & S.M.Burrows, sp. nov., *A. amythethophyllae* similis sed cortice pallida sublaeve, spinis magnis conspicuis stipularibus usque ad 45 mm latis 50 mm longisque, pinnulis oblongo-falcatis superficie inferiore glandulis complanatis perparvulis dense obsita, differt.

TYPE.—Mozambique, Cabo Delgado Province, 14.8 km from the main Pemba-Metoro road, on road to Mecufi, 13°11'13"S, 40°33'10"E, 23 December 2006, J.E. Burrows & S.M. Burrows 9764 (PRE, holo.; BNRH, K, LMA, iso.).

Deciduous tree up to 7 m tall. *Bark* smoothish, pale, beige-brown, flaking; branchlets glabrous, pale grey-beige, lenticellate, splitting longitudinally; new growth branchlets red-brown, smooth, glabrous. *Stipules* paired, spines up to 50 × 45 × ± 2 mm, unmistakably large and flattened, roughly triangular in outline, the flared basicopic lobe margins folded over in larger stipules,

spines held at ± 90° to stem. *Leaves* bipinnate, glabrous throughout, but lower surface of pinnules densely set with minute, pale, flattened glands, ± 0.04 mm diam., resulting in lower surface appearing paler than upper; petiole 18–24 mm long, faintly 4-ribbed, pulvinus with crateriform ellipsoid nectariferous gland ± 4 mm long, and a pair of peg-like linear-clavate (stipitate) glands ± 2 mm long on adaxial pair of petiolar wings ± 10 mm up from petiole base; rachis 65–135 mm long, somewhat dorsiventrally flattened, 4-angled, each angle very narrowly winged, with a circular gland ± 2 mm diam. between terminal pair of pinnae; pinnae in 9–12 pairs (3–6 in juvenile leaves), rachillae 28–54 mm long, faintly winged; leaflets in (10–)14–16(–20) pairs per pinna, oblong-falcate, 6–10 × 2–4 mm, apex acute, base asymmetrically truncate. *Inflorescences* capitate, globose, bright yellow, 9–12 mm diam., borne in axillary fascicles of 3–5 per fascicle, among new leaves or on pseudopaniculate leafless terminal shoots; peduncle 22–28 mm long, involucre below middle, mainly at 35–45 % of the peduncle length, glabrous. *Flowers* pentamerous, yellow; bracteoles 1 mm long, broadly clavate, margins lacerate. *Calyx* cupuliform, ± 1 × 0.8 mm, shallowly toothed with broadly acute teeth, margins with a few minute hairs. *Corolla* cylindrical, 2–3 mm long, glabrous, lobes narrowly acute, ± 0.8 mm long, margins entire to pustulate. *Pods* flat, thin, somewhat raised over seeds, 130–170 × 18–21 mm, dark grey when dry, margins ± straight, slightly thickened, venation reticulate, raised when dry. *Seeds* 8–12 per pod, oblong-elliptic, compressed, ± 6 × 5 × 2 mm, dull mid-brown, areole pale, horseshoe-shaped, 4 × 2.7 mm. Figures 3, 4.

TABLE 1.—Differences between *Acacia latispina* and *A. amythethophylla*

Character	<i>A. latispina</i>	<i>A. amythethophylla</i>
Bark	smoothish, pale, beige-brown, flaking	rough dark grey to blackish, fissured longitudinally (Drummond 1981; Timberlake <i>et al.</i> 1999)
Stipules	unmistakeably large and flattened, roughly triangular in outline and up to 50 × 45 mm	short, straight and dark, although sometimes 8–16 mm, neither conspicuous nor numerous (Coe & Beentjie 1991 [as <i>A. macrothyrsa</i>]; Timberlake <i>et al.</i> 1999; Coates Palgrave 2002)
Petiole	4-angled, faintly 4-ribbed	sulcate
Petiolar glands	2 peg-like, linear-clavate glands 2 mm long on adaxial petiolar wings	peg-like petiolar glands absent
No. of pinnae	3–12	7–35
Pinnule shape	oblong-falcate	narrowly oblong to linear-oblong
Pinnule undersurface	densely set with minute pale flattened glands	eglandular
Habitat	coastal woodland, within sight of sea	platau (often miombo) woodland, mainly between 500 and 1 500 m (1 200–1 800 in East Africa); never coastal

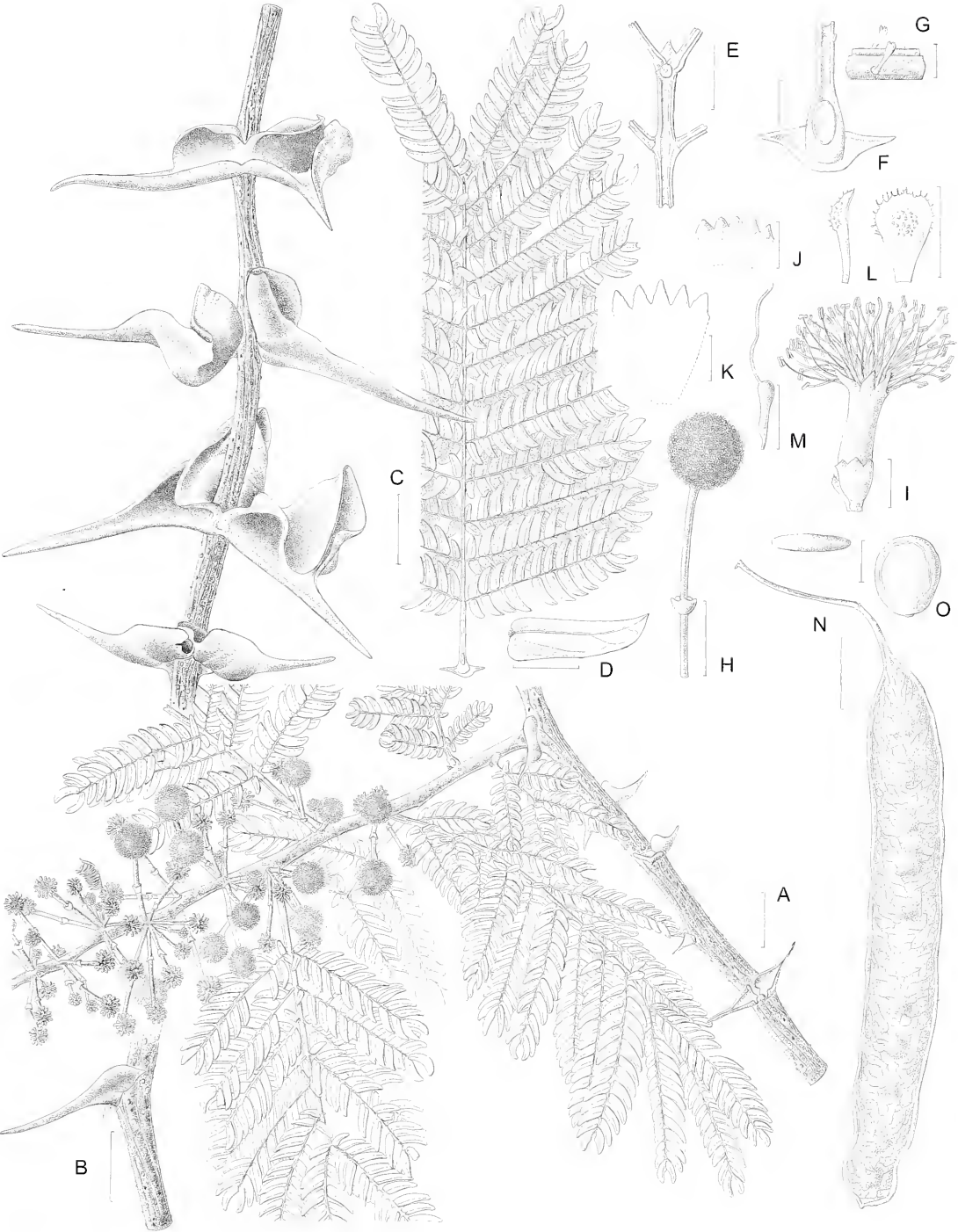


FIGURE 3.—*Acacia latispina*, A–O, J.E. Burrows & S.M. Burrows 9764. A, flowering branchlet; B, branchlet with stipules; C, leaf; D, pinnule; E, rachilla; F, petiole; G, clavate petiolar glands; H, inflorescence; I, floret; J, calyx; K, corolla; L, bracteoles; M, gynoeceum; N, pod; O, seeds. Scale bars: A–C, N, 20 mm; D, O, 4.5 mm; E, 7 mm; F, 4 mm; G, 2 mm; H, 10 mm; I–L, 1 mm; M, 1.5 mm. Artist: Sandra Burrows.

Diagnostic features and affinities: *Acacia latispina* is most closely allied to *A. amythephylla* Steud. ex A.Rich. but is unmistakably distinct from that species by virtue of its prominently large, winged stipules. The coastal habitat of *A. latispina* is also quite different to that of *A. amyth-*

ephylla, the latter being almost invariably a species of plateau and escarpment woodland, largely associated with the miombo genera of *Brachystegia* and *Julbernardia* (Caesalpinaceae). A more detailed tabulated comparison of the two taxa is given in Table 1.



FIGURE 4.—*Acacia latispina*, habit at type locality, October 2005. Photographer: John Burrows.

Further afield, it is noted that *Acacia latispina* bears some resemblance to the Mexican species *A. cochliacantha* Humb. & Bonpl. ex Willd. The latter taxon has flattened spines which become spoon-shaped with age, reaching 60 mm long and 40 mm wide (Sieglar & Ebinger 1988; www.worldwidewattle.com). It is interesting to note this example of convergent evolution whereby this feature of ‘spoon-shaped’ spines has developed independently in two taxonomically unrelated species, on two different continents, although the spines of *A. latispina* are generally thinner and more convoluted than those of the New World *A. cochliacantha*.

Distribution and habitat: known only from the type locality (Figure 5), despite fairly extensive exploration of the surrounding Pemba District. *Acacia latispina* grows in an open coastal woodland/scrub mosaic on sandy, pebbly soils on the first levee behind the coastal dunes, at an altitude of about 20 m. This new taxon adds yet another endemic species to the flora of the coastal belt of northeastern Mozambique, a region that is increasingly becoming recognized as a region of botanical diversity and endemism (Lock 2006; Burrows 2009).

Conservation status: because the species is currently known only from the type locality, where $\pm 1\,000$ plants are estimated to occur within an area of 25 km², and because the area between Pemba and Mecufi is under

pressure from continued rural development, we recommend an IUCN RDL status of Endangered (B2a,c) (IUCN 2001).

Note: this species is deliberately described here under the genus *Acacia*, in the full knowledge that there remain contentious issues surrounding the circumscription of the genus *Acacia sensu lato*. Until such time as the legality of the proposed generic name changes is settled, and the name *Acacia* is universally accepted as not being applicable to African members of the group, we prefer to retain the generic name *Acacia* for the African species.

ACKNOWLEDGEMENTS

We gratefully acknowledge Dr Hugh Glen for the Latin diagnosis, and the Instituto de Investigação Agrária de Moçambique (IIAM) for permission to collect plants in Mozambique. The anonymous referee who pointed out the similarity of this species to the Mexican *Acacia cochliacantha* is sincerely thanked.

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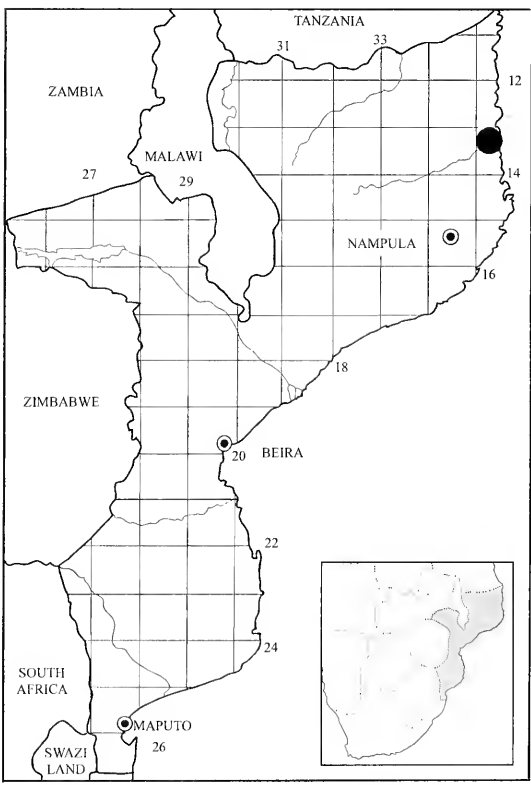


FIGURE 5.—Known distribution of *Acacia latispina*.

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MS received: 2009-05-20.

HYACINTHACEAE

DRIMIA OLIVERORUM (URGINEOIDEAE), A NEW SPECIES FROM SOUTHERN NAMIBIA

The genus *Drimia* Jacq. comprises over 100 species of mainly deciduous geophytes distributed through Africa into the Mediterranean and Asia, with a marked centre of diversity in southern Africa (Manning *et al.* 2004). It is characterized in the family Hyacinthaceae by its short-lived, caducous flowers, mostly rather inconspicuously coloured dull cream, grey or brownish (Manning *et al.* 2002). The genus is well represented in the southern African winter rainfall zone (Goldblatt & Manning 2000), where the species typically have hysteranthous leaves, and several new species have been described from the region in recent years (Müller-Doblies *et al.* 2001; Tang & Weiglin 2001; Manning & Goldblatt 2003, 2007).

Within *Drimia* the small group of ± 12 species previously recognized as the genus *Rhadamanthus* Salisb. (Nordenstam 1970; Obermeyer 1980; Snijman *et al.* 1999) is distinguished by their mostly campanulate to urceolate flowers, stamens with very short filaments up to 2.5 mm long, anthers \pm connivent over the ovary and often dehiscing incompletely by apical pores or short slits, and the frequent presence of longitudinal lines of short pubescence on the lower part of the peduncle (Manning *et al.* 2002). Most of the species in the group are endemic to the winter rainfall region of southwestern South Africa and southern Namibia. Sterile plants collected several years ago by botanists Ted and Inge Oliver and which later flowered in cultivation, represent the third species in the group known from southern Namibia. The taxon had been independently collected, again only in leaf, more than a decade earlier by Swedish botanist Bertil Nordenstam, who had recognized it as distinct at the time under the manuscript name *Rhadamanthus monophyllus*, but the plants failed to produce flowers. The distinctive foliage combined with relatively unspecialized flowers are diagnostic for the species, which is named for the Olivers in recognition of their interest in the genus.

Drimia oliverorum J.C.Manning, sp. nov.

Herba bulbosa decidua. *Folium* proteranthum, unicum, \pm patens, ellipticum ad ovatum, longitudine striatum, $15\text{--}20 \times 7\text{--}10$ mm, adaxialiter dense velutinum. *Inflorescentia* erecta scapo basaliter longitudinaliter papillato; racemus laxe 4-florigenus; bractae calcaratae. *Flores* paulum nutantes, vadose campanulati, roseo-albidi costa

atrorosea, inodori; tepala obovata, $\pm 5.0 \times 2.5$ mm, basalliter ± 1 mm connata. *Stamina* perigono ± 0.5 mm adnata, filamenta incurva, laevia, subteretia, 1 mm longa; antherae conniventes, ab apice ad dimidium rimis longitudinalibus dehiscentes, thecae basaliter rotundatae glabraeque, 1.8 mm longae. *Ovarium* ovoideum, 1.8 mm longum; stylus columnaris, 1.8 mm longus.

TYPE.—Namibia, 2716 (Witputz): Huib Hoch Plateau, Zebrasfontein, (–DB), 1 200 m, 29 June 1989 [in leaf only], E.G.H. Oliver & I.M. Oliver 9164 (NBG, holo.).

Deciduous, bulbous herb. *Bulb* solitary, subglobose, ± 15 mm diam.; outer tunics pale brown, thinly leathery. *Leaf* dry and withered at flowering, solitary, spreading, leathery or subsucculent, base amplexicaul; blade elliptic to ovate, $15\text{--}20 \times 7\text{--}10$ mm, with 2 solitary or paired, depressed longitudinal striations, apically notched or toothed, dark green, densely velutinous adaxially. *Inflorescence* erect; scape up to 80 mm long, with minute papillae arranged in vertical lines basally; raceme ± 20 mm long, laxly 4-flowered; bracts spurred, $1.5\text{--}2.0$ mm long, spur $0.5\text{--}1.0$ mm long. *Flowers* slightly nodding, shallowly campanulate, 1 or 2 open at a time, pinkish white with darker midrib, unscented; tepals obovate, apically penicillate, $\pm 5.0 \times 2.5$ mm, fused basally for ± 1 mm; pedicels patent, $5\text{--}7$ mm long. *Stamens* adnate to perigone for ± 0.5 mm; filaments incurved, smooth, subterete, 1 mm long; anthers connivent, arching inward and covering ovary, dehiscing by longitudinal slits from apex to halfway, thecae rounded and glabrous basally, 1.8 mm long. *Ovary* ovoid, 1.8 mm long; style columnar, 1.8 mm long. *Capsule and seeds* unknown. *Flowering time*: not recorded, probably October–November. Figure 6.

Distribution and ecology: known from two collections in extreme southern Namibia (Figure 7). At the type locality on the Huib Hoch Plateau, a few, very localized leafing plants were seen growing on loamy flats among numerous dark brown stones in sparse, short, karroid scrub. At the time there were indications of sheep having grazed in the area. On a subsequent visit to the precise locality in July 2006, a thorough search revealed no plants even though the area had received good summer rains with a few areas nearby showing fine patches of flowering annuals and with no signs of grazing having occurred. A plant that subsequently flowered

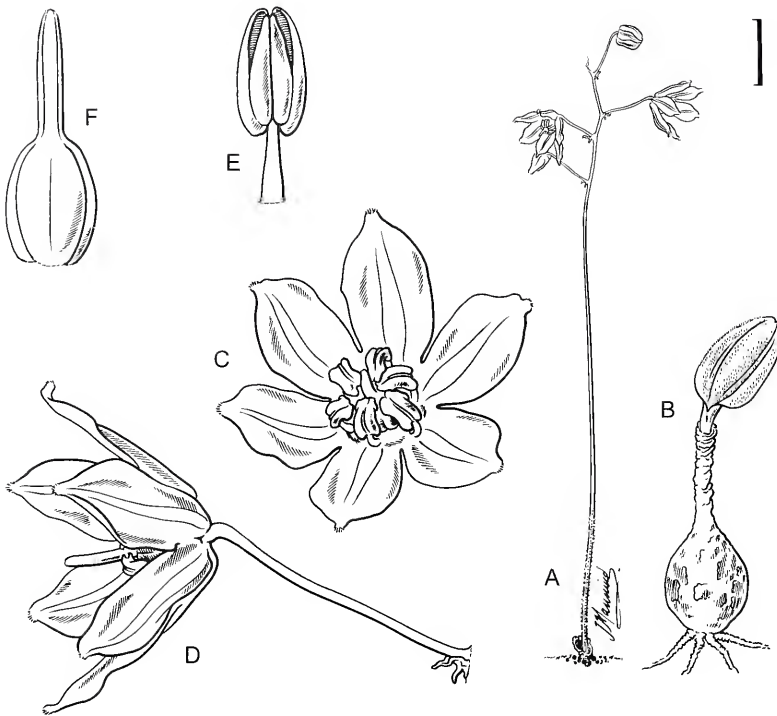


FIGURE 6.—*Drimia oliverorum*, Oliver & Oliver 9164 (NBG). A, inflorescence; B, vegetative plant. C, D, flower: C, front view; D, side view. E, stamen; F, gynoecium. Scale bar: A, B, 10 mm; C, D, 3 mm; E, F, 1 mm. Artist: John Manning.

in cultivation allowed the description and illustrations to be prepared. The second known locality is some 70 km to the west at a somewhat lower altitude near Ai-Ais, where plants were found in gravelly patches on a quartzite ridge.

The Huib Hoch plateau and adjacent highlands in southern Namibia have been identified as the Gariiep Centre of endemism for the Namibian flora (Craven & Vorster 2006). More than 40 species in various families have been recorded as endemic to the centre, including several species of Hyacinthaceae, especially in the genera *Albuca*, *Lachenalia*, *Massonia* and *Ornithogalum*.

Diagnosis and relationships: the \pm nodding, campanulate flowers with very short filaments and connivent anthers dehiscing incompletely from an apical slit, place *Drimia oliverorum* firmly among the *Rhadamanthus* group of *Drimia* (Manning *et al.* 2002). Although unremarkable within the alliance in its flowers, the unusual prostrate leaf with ovate-elliptical, velutinous blade bearing depressed, longitudinal striations, is shared only with *D. platyphylla* (B.Nord.) J.C.Manning & Goldblatt, suggesting a close relationship between the two. *D. platyphylla* is widespread through the western half of South Africa and has also been recorded from central Namibia (Nordenstam 1970). It differs from *D. oliverorum* in its mostly paired leaves, distinctly nodding, urceolate flowers with papillate-puberulous filaments and sagittate anthers with basally diverging thecae barbellate at the base, and in the very short style, distinctly shorter than the leaf. The leaf in *D. oliverorum* is invariably solitary, and the shallowly campanulate flowers are scarcely nodding, with anther thecae parallel and unadorned at the base, and style subequal to the ovary in length.

Specimens of *Drimia platyphylla* with the diagnostic stamens of the species have been recorded through-

out Namaqualand as far north as the Richtersveld but thus far not from southern Namibia. However, all non-flowering plants from the Richtersveld and southern Namibia with the distinctive leaves of this species should be carefully examined in the light of the discovery of the vegetatively similar *D. oliverorum* from southern Namibia.

Additional material examined

Drimia oliverorum

NAMIBIA.—2717 (Chamaites): Warmbad Dist., road junction to Ai-Ais, 11 km from Ai-Ais, (–DC), quartzite ridge with gravel and stones, 27 June 1974, Nordenstam & Lundgren 180 (NBG, S).

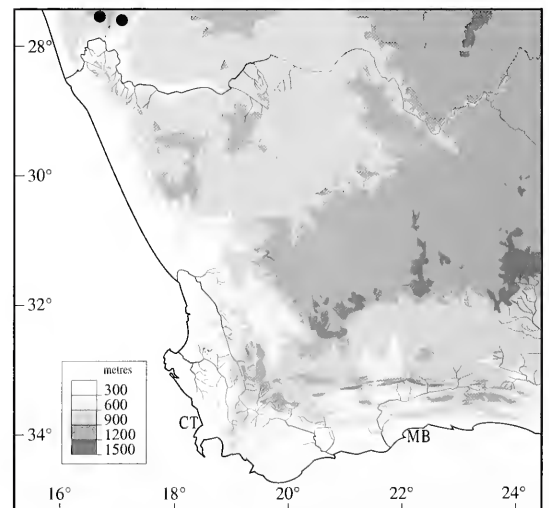


FIGURE 7.—Known distribution of *Drimia oliverorum*.

Drimia platyphylla

NORTHERN CAPE.—2817 (Vioolsdrif): Richtersveld, Dolomite Peaks, (–CA), 10 August 1979, *Perry 1140* (NBG); Richtersveld, Karachabpoort, (–CC), 9 March 1979, *Perry 912* (NBG). 3017 (Hondeklipbaai): 16 miles [25.6 km] SW of Garies, (–DB), 19 August 1970 [cult. January 1972], *H. Hall 3764* (NBG).

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PTERIDOPHYTA

OTTO KUNTZE'S LYCOPOD AND FERN COLLECTIONS FROM SOUTH AFRICA

Carl Ernst Otto Kuntze visited South Africa from 8 January–24 March 1894. The itinerary of this infamous botanist is published in volume 3 of his *Revisio generum plantarum* (1898) and contains an account of the plants he collected during his 18 month stay in South America (1891–1892), and his visit to South Africa. A detailed account of Kuntze's travels in South Africa is provided by Zanoni (1980) and Gunn & Codd (1981).

Dyer (1941) gave an account of the new species based on Kuntze's South African collections, but he omitted the *Cryptogamae vasculares*—the lycopods and ferns, published on pages 376–381 (part 3) of volume 3 of the *Revisio*. The American ferns collected during his stay there were dealt with by F.A.M. Kuhn, whereas Kuntze dealt with the South African ferns himself. The larger part of Kuntze's herbarium is housed in the New York Botanical Garden Herbarium (NY) where I recently had the opportunity to study many of Kuntze's South African lycopod and fern collections.

Kuntze has been described as a controversial nomenclatural reformer. He did not accept the 1867 Candolle's Laws, or Paris Code of Botanical Nomenclature and published 1 074 replacement generic names and more than 30 000 new combinations in the first two volumes of his *Revisio* (1891). He also accepted 1735, the publication date of the first edition of Linnaeus's *Systema naturae* as the starting point of generic names. It must be noted that the Paris Code was a set of rules that, at the time, had no international standing. Only with the adoption of the first *International Rules of Botanical Nomenclature* in 1906 (Briquet 1906) (subsequently the *International Code of Botanical Nomenclature*), was 1 May 1753, the publication date of Linnaeus's *Species plantarum*, officially accepted as the starting point for the use of the binomial naming system. When proposing new combinations, Kuntze cited

his name first, followed by the author of the basionym in brackets, i.e. *Allosorus involutus* O.Ktze (Sw.). The abbreviation of Kuntze's name in this publication is used somewhat inconsistently but is regularly given as OK.

In dealing with the *Cryptogamae vasculares* of South Africa, Kuntze proposed three new combinations, described four new varieties, and one new form. Apart from a list of Kuntze's types in NY (Zanoni & Schofield 1981), the list has been unnoticed or ignored until now, as none of the combinations made by him in volume 3 of the *Revisio* are listed in any of the works dealing with South Africa's lycopod and fern flora.

A complete list of the South African taxa, the locality where originally collected, and the combinations proposed by him in the *Revisio* volumes are provided here. The first name, complete with author citation, is the name used by Kuntze and is printed in italics. The currently accepted name is printed in bold. Collecting details are provided for all the newly described taxa. Lectotypifications are made for *Notholaena inaequalis* Kunze γ *eckloniana* (Kunze) Kuntze var. *rawsonii* (Pappe) Kuntze forma *minor* Kuntze and *Spicanta punctulata* (Sw.) Kuntze var. *swellendamensis* Kuntze. If no specimen of a name is mentioned, the specimens were not found at NY in February 2009 by the present author.

Allosorus calomelanos C.Presl = *Allosorus calomelanos* (Sw.) C.Presl = *Pellaea calomelanos* (Sw.) Link. Südafrika: Bloemfontein, Beaufortwest, Cogmanskloof, Van Reenen's Pass.

Allosorus involutus (Sw.) Kuntze, *Revisio generum plantarum* 2: 806 (5 Nov. 1891). Isonym for *Allosorus involutus* (Sw.) C.Presl = *Cheilanthes involuta* (Sw.) Schelpe & N.C. Anthony. Transvaal: Pretoria.

Allosorus quadripinnatus (Forssk.) Kuntze, *Revisio generum plantarum* 2: 806 (5 Nov. 1891). Isonym for *Allosorus quadripinnatus* (Forssk.) C.Presl = *Cheilanthes quadripinnata* (Forssk.) Kuhn. Capland: Cathcart.

Allosorus viridis (Forssk.) Kuntze, Revisio generum plantarum 2: 806 (5 Nov. 1891) = **Cheilanthes viridis** (Forssk.) Sw. Capland: Perie-Wald.

Asplenium protensum Schrad. Capland: Perie-Wald.

Asplenium rutifolium Kunze = **Asplenium rutifolium** (P.J.Bergius) Kuntze. Capland: Perie-Wald.

Cheilanthes hirta Sw. Capland: Molteno.

Cheilanthes parviloba Sw. = **Cheilanthes parviloba** (Sw.) Sw. Capland: Cogmanskloof.

Cyathea dregei Kunze = **Alsophila dregei** (Kunze) R.M.Tryon. Capland: Toise River Station.

Dryopteris adiantiformis (G.Forst.) Kuntze, Revisio generum plantarum 3,3: 378 (28 Sep. 1898) = **Rumohra adiantiformis** (G.Forst.) Ching. Capland: Perie-Wald.

Dryopteris filix-mas (L.) Schott = **Dryopteris pentheri** (Krasser) C.Chr. Natal: Van Reenen's Pass. Three sheets from this locality, presumably from the same plant, exist at NY.

Dryopteris filix-mas (L.) Schott var. *elongata* Hook. & Baker = **Dryopteris inaequalis** (Schltdl.) Kuntze, Revisio generum plantarum 2: 813 (5 Nov. 1891). Capland: Perie-Wald.

Gleichenia polypodioides (L.) Sm. Natal: Krantzskloof.

Gymnogramme lanceolata (Sw.) Hook. = **Loxogramme abyssinica** (Baker) M.G.Price. Capland: Perie-Wald.

Hemitelia capensis (L.f.) Kaulf. = **Alsophila capensis** (L.f.) J.Sm. Capland: Swellendam.

Hypolepis bergiana (Schltdl.) Hook. = **Cheilanthes bergiana** Schltdl. Capland: Perie-Wald.

Hypolepis sparsisora (Schrad.) Kuhn, as '*sparsiflora*'. Capland: Perie-Wald.

Lycopodiodes kraussianum (Kunze) Kuntze, Revisio generum plantarum 2: 826 (5 Nov. 1891) = **Selaginella kraussiana** (Kunze) A.Braun ex Kuhn. Capland: Perie-Wald.

Lycopodium cernuum L. = **Lycopodiella cernua** (L.) Pic.Serm. Natal: Krantzskloof.

Mohria caffrorum Kunze = **Mohria vestita** Baker. Three collections were located at NY: 1. Capland, Cathcart, 1 400 m, 25-2-1894; 2. Zwaartkop, Natal, 960 m, 13-3-1894; 3. Van Reenen's Pass, Natal, 1 000 m, 20-3-1894. Kuntze in the publication gives: Natal: 550-1 800 m. Capland: Cathcart.

Notholaena inaequalis Kunze *a tomentosa* Kuntze var. *normalis* Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Cheilanthes eckloniana** (Kunze) Mett. Var. *normalis* is an autonym of *a. tomentosa* under the current Code [McNeill *et al.* (2006) Articles 24,3, 26]. Type: Capland: Middelburg Road, 1 350 m, 13-2-1894, Kuntze s.n. (NY127454, holo.).

Notholaena inaequalis Kunze *a tomentosa* Kuntze var. *minor* Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Cheilanthes eckloniana** (Kunze) Mett. Type: Capland: Middelburg Road, 13-2-1894, Kuntze s.n. (NY127455, holo.).

Notholaena inaequalis Kunze *a tomentosa* Kuntze var. *buchananii* (Baker) Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Cheilanthes inaequalis** (Kunze) Mett. var. *buchananii* (Baker) Schelpe.

Notholaena inaequalis Kunze *β pilosa* Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Cheilanthes contracta** (Kunze) Mett. ex Kuhn. Type: Capland: Cogmanskloof, Kuntze s.n. (NY127456!, holo.; NY127457!, iso.). Note: even though the New York Herbarium specimen numbers differ, they are duplicates of the same collection.

Notholaena inaequalis Kunze *γ eckloniana* (Kunze) Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Cheilanthes eckloniana** (Kunze) Mett.

Notholaena inaequalis Kunze *γ eckloniana* (Kunze) Kuntze var. *rawsonii* (Pappe) Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898) as '*Notochlaena*' = **Cheilanthes rawsonii** (Pappe) Mett. ex Kuhn.

Notholaena inaequalis Kunze *γ eckloniana* (Kunze) Kuntze var. *rawsonii* (Pappe) Kuntze forma *minor* Kuntze, Revisio generum plantarum 3,3: 379 (28 Sep. 1898), as '*Notochlaena*' = **Asplenium cordatum** (Thunb.) Sw. Type: Capland: Cradock, 940 m, 12-2-1894, Kuntze s.n. (NY1, lecto., here designated).

Kuntze's diagnosis for forma *minor* is given as '*frons angusta*' and it is based on material from Cradock. Two specimens from this locality are present at NY. The name forma *minor* is not provided on any labels of the two specimens. One sheet consists of nine separately mounted fronds of *Asplenium cordatum*, whereas the second sheet has three mounted specimens. Specimen A (specimens numbered by me on the sheet) is *A. cordatum*, whereas specimens B and C are *Cheilanthes eckloniana*. *Cheilanthes rawsonii* does not occur in the Cradock District, but rather in the northwestern corner of South Africa and southwestern parts of southern Namibia, an area not visited by Kuntze. As with many of Kuntze's collections, the material is not well prepared and these collections are no exception. It is perhaps for this reason that the material is incorrectly identified. The sheet with the nine separately mounted fronds is here selected as lectotype of forma *minor* as it conforms to the brief diagnosis.

Polypodium incanum Sw. = **Pleopeltis polypodioides** (L.) E.G.Andrews & Windham subsp. *ecklonii* (Kunze) J.P.Roux. Capland: Perie-Wald.

Polypodium lanceolatum L. var. *sinuatum* Sim = **Polypodium simianum** Schelpe & N.C.Anthony. Capland: Cathcart.

Polypodium lineare Thunb. Natal: Van Reenen's Pass. Most likely **Pleopeltis macrocarpa** (Bory ex Willd.) Kaulf. or **Lepisorus schraderei** (Mett.) Ching.

Polypodium phymatodes L. = **Microsorium scolopendria** (Burm.f.) Copel. Süd-Afrika: Delagoa Bay.

Pteris flabellata Thunb. as '*flabellulata*' = **Pteris dentata** Forssk. Capland: Perie-Wald.

Schizaea pectinata Sm. = **Schizaea pectinata** (L.) Sw. Capstadt: Devil's Peak.

Spicanta punctulata (Sw.) Kuntze, Revisio generum plantarum 2: 822 (5 Nov.1891) = **Blechnum punctulatum** Sw. var. *punctulatum*. Capland: Molteno, Caledon.

Spicanta punctulata (Sw.) Kuntze var. *swellendamensis* Kuntze, Revisio generum plantarum 3,3: 381 (28 Sep. 1898) = **Blechnum punctulatum** Sw. var. *punctulatum*. Type: Capland: Swellendam, 300 m, 20-1-1894, Kuntze s.n. (NY127458!—fertile frond, lecto., here designated; NY127461!—sterile frond, iso.). Note: even though the New York Herbarium specimen numbers differ, they are duplicates of the same collection.

Todea barbara T.Moore = **Todea barbara** (L.) T.Moore. Capland: Swellendam.

Trichomanes pyxidiferum L. Most likely **Crepidomanes melanotrichum** (Schltdl.) J.P.Roux. Capland: Perie-Wald.

Zahizianskya capensis (A.Braun) Kuntze, Revisio generum plantarum 2: 823 (5 Nov.1891) = **Marsilea capensis** A.Braun. Capland: Molteno.

ACKNOWLEDGEMENTS

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HYACINTHACEAE

Pseudogaltonia liliiflora (ORNITHOGALOIDEAE), A NEW SPECIES FROM THE RICHTERSVELD, NORTHERN CAPE

Hyacinthaceae, optionally included in Asparagaceae (Angiosperm Phylogeny Group—APGII 2003), are a family of 700–900 species of bulbous geophytes, with centres of diversity in both southern Africa and the Mediterranean (Speta 1998). Current classifications recognize the four subfamilies Oziroëoideae, Ornithogaloideae, Urgineoideae and Hyacinthoideae (Speta 1998; Manning *et al.* 2004). Subfamily Ornithogaloideae, which comprises ± 300 species, has recently been the subject of extensive generic re-arrangements but the most modern classification of the subfamily recognizes four genera in three tribes: *Albuca* L. (tribe Albucaeae J.C.Manning & Goldblatt), *Ornithogalum* L. (tribe Ornithogaleae Rouy), *Pseudogaltonia* (Kuntze) Engl. and *Dipcadi* Medik. (tribe Dipcadiaceae Rouy) (Manning *et al.* 2009). The two largest genera are *Albuca* (± 100 spp.) and *Ornithogalum* (± 160 spp.), followed by *Dipcadi* (± 30 spp.) and *Pseudogaltonia*, which was until now monotypic, comprising *P. clavata* (Mast.) E.Phillips from the arid western parts of southern and south tropical Africa. *Pseudogaltonia* is distinguished in the subfamily by its large bulb with coarsely fibrous, reticulate outer tunics, flowers with a well-developed perianth tube and relatively short, triangular filaments inserted at the mouth of the tube, quadrate capsules with disciform seeds, and especially by well-developed bracteoles, which are solitary and inserted at the base of the pedicels (Manning *et al.* 2009). The presence or absence of bracteoles in the family is largely a generic character, and although encountered in subfamilies Oziroëoideae and Hyacinthoideae it is unique to *Pseudogaltonia* among Ornithogaloideae.

A collection of a robust plant from the Richtersveld made by Graham Williamson during the preparation of his book on the region (Williamson 2000) was identified as *Pseudogaltonia clavata*, and thus a major range extension for the species, but closer examination reveals a number of significant differences from typical *P. clavata*. The solitary flowering stem that was preserved is augmented by a clear photograph taken of the plant in the wild [Figure 8A, reproduced in Williamson (2000) as *Lindneria clavata*]. It clearly represents a novel taxon that is described here as the new species *P. liliiflora*, and is thus the second species known in the genus and another of numerous Hyacinthaceae that are endemic to the Gariep Centre of Endemism (Van Wyk & Smith 2001).

***Pseudogaltonia liliiflora* J.C.Manning & Goldblatt**, sp. nov., a *P. clavata*, pedicellibus brevioribus 15–20 mm longis, floribus horizontaliter extensis, corolla ore sursum spectanti, tepalis anguste oblongis 15–17 \times 4 mm, filamentis 4 \times 1.2 mm, antheris patentibus \pm 5 mm longis, stylo recto \pm 20 mm longo differt.

TYPE.—Northern Cape, 2817 (Vioolsdrif): Richtersveld, Vandersterrberg, gorge of Oemsberg, (–AC), 25 April 1988, G. Williamson 3869 (NBG, holo.).

Bulbous geophyte up to 1.3 m tall. *Leaves* rosulate, erect, glaucous (*vide* Williamson 2000). *Inflorescence* many-flowered, congested, ovoid but elongating and becoming cylindrical in fruit; pedicels 15–20 mm long, spreading \pm horizontally in flower but suberect in fruit; bracts deflexed, lanceolate-attenuate, 20–30 \times 3–4 mm, membranous; bracteoles solitary, erect-spreading, lanceolate, 10–12 \times 1.5–2.0 mm. *Flowers* spreading \pm horizontally with mouth facing upwards, pale greenish white; perianth tube 15–25 mm long, slightly swollen basally, sharply upcurved apically, tepals narrowly oblong, 15–17 \times 4 mm, recurved. *Stamens* inserted in mouth, suberect; filaments triangular, 4 \times 1.2 mm, connate basally; anthers \pm 5 mm long, anthers and pollen greenish. *Ovary* ovoid, obtuse or truncate apically, narrowed basally, 13 \times 8 mm; style straight, \pm 20 mm long, white; stigma capitate, \pm 1.5 mm diam. *Capsules* and *seeds* unknown. *Flowering time*: April. Figures 8A, 9A & B.

Distribution and ecology: *Pseudogaltonia liliiflora* is known from two locations in the mountainous northern Richtersveld (Figure 10), where scattered colonies occur on rocky slopes in deep, steep-sided gorges. Plants are restricted to south-trending slopes which are shaded for much of the day. These gorges are often filled with mist during the winter months, which supplements the meagre annual rainfall in the region (Williamson 2000). The type collection was made from the upper reaches of the Gannakouriep River, on the lower southwestern slopes of the gorge between the Vandersterrberg and Tswaies Mountains but there is a sight record of a second population (G. Williamson pers. comm.) \pm 20 km southwest of this in the Doringpoort, which runs down from the western edge of the Ploegberg.

Diagnosis and relationships: *Pseudogaltonia liliiflora* resembles *P. clavata* in its robust, congested raceme of

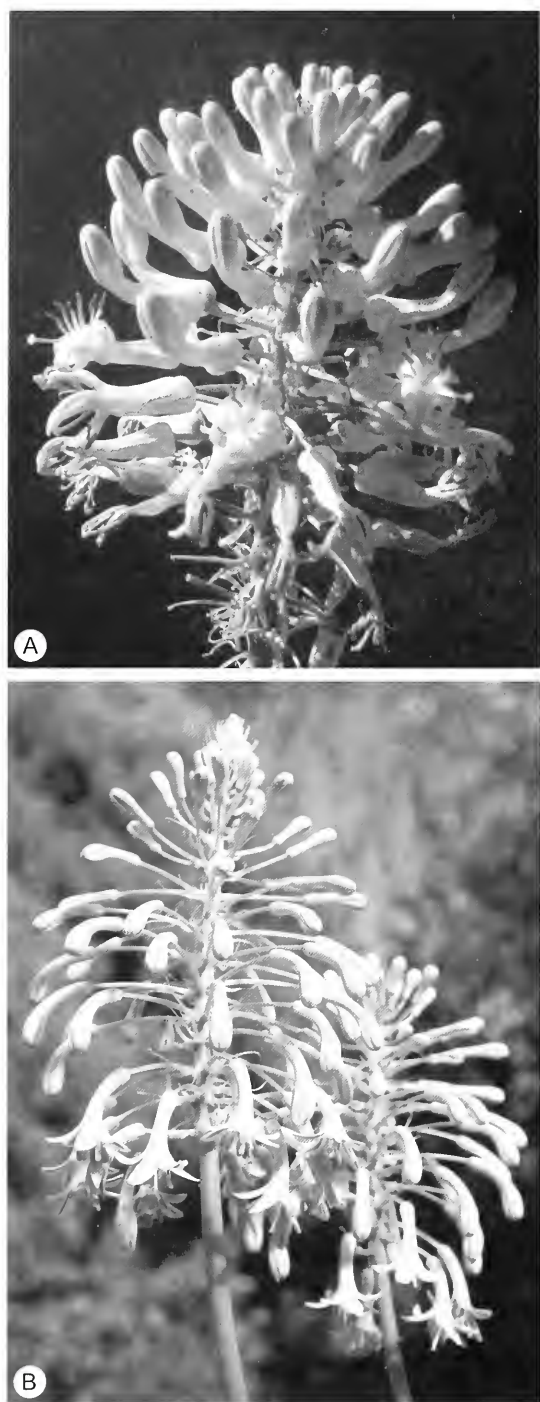


FIGURE 8.—A, *Pseudogaltonia liliiflora*, Williamson 3869. Inflorescence. Photographer: G. Williamson. B, *P. clavata*. Photographer: J. Manning.

pale, greenish white, tubular flowers but differs sharply from it in the shape and orientation of the flowers, and in the much larger bracts and bracteoles (Figures 8A; 9A & B). The flowers of *P. liliiflora* spread \pm horizontally and are sharply upcurved at the tips (this is very evident in bud), with the mouth of the tube facing upwards. The

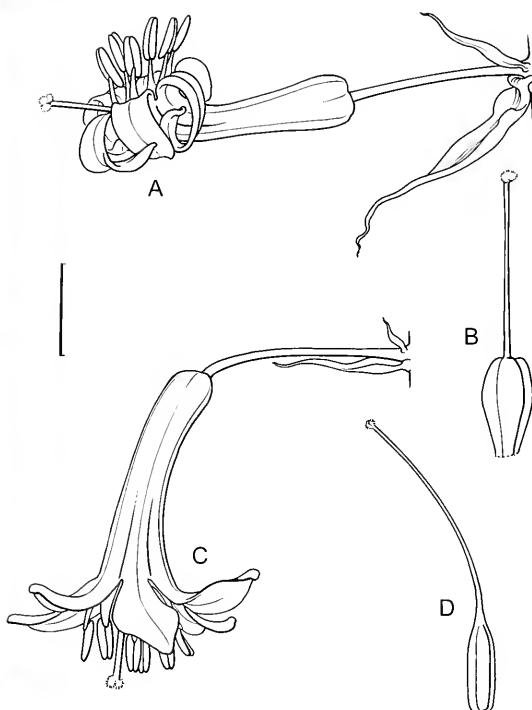


FIGURE 9.—*Pseudogaltonia liliiflora*, Williamson 3869: A, flower with bract and bracteole; B, gynoecium. *P. clavata*: C, flower with bract and bracteole; D, gynoecium. Scale bar: 10 mm. Artist: John Manning.

oblong tepals, $15\text{--}17 \times 4$ mm, recurve sharply back from the mouth of the tube to expose the filaments and style. The style is straight and thus projects horizontally from between the bases of the upward-pointing filaments. The large, conspicuous bracts, $20\text{--}30 \times 3\text{--}4$ mm, are longer than the pedicels and \pm twice as large as the bracteoles, with which they become entangled, almost obscuring the rachis. In contrast, the flowers of *P. clavata* are decurved in bud and distinctly nodding at maturity, with the perianth tube slightly downcurved so that the mouth faces directly downwards (Figures 8B; 9C & D). The elliptical tepals, $12\text{--}14 \times 5\text{--}6$ mm, are spreading or suberect and partially conceal the stamens, and the style, which is slightly longer ($25\text{--}30$ mm), is curved basally to follow the shape of the perianth tube, and thus projects directly downwards from the centre of the surrounding filaments. The bracts in *P. clavata* are significantly smaller than those in *P. liliiflora*, $10\text{--}15 \times 2\text{--}3$ mm, only half to three-quarters as long as the pedicels and spreading, and the bracteoles are also correspondingly smaller, $5\text{--}6 \times 1.5\text{--}2.0$ mm. There also seem to be differences between the two taxa in the shape of the ovary and fruit but mature material of *P. liliiflora* is required to assess this properly. The ovary and the immature fruit of *P. liliiflora* that we have been able to examine are obtuse or truncate apically, whereas the ovary in *P. clavata* narrows imperceptibly into the style, and the developing and mature fruits are distinctly apiculate.

The two species are geographically and ecologically distinct, with *Pseudogaltonia liliiflora* confined to rocky

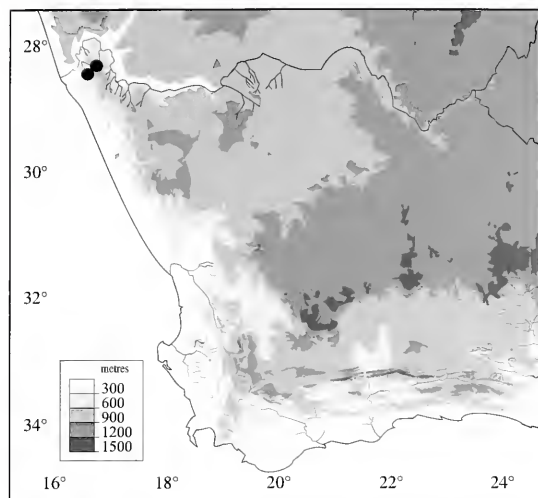


FIGURE 10.—Known distribution of *Pseudogaltonia liliiflora*.

gorges in the Richtersveld, in the winter rainfall part of the region, in contrast to *P. clavata*, which is widespread from Angola through the summer rainfall parts of Namibia and the western parts of Botswana and South Africa, where it occurs in drier savanna on sandy and calcareous flats or near dry rivers and pans (Van Rooyen 2001; Figueiredo & Smith 2008).

HYACINTHACEAE

A NEW SUBSPECIES OF *PSEUDOPROSPERO FIRMIFOLIUM* (HYACINTHOIDEAE) FROM KWAZULU-NATAL

The monospecific South African *Pseudoprospéro* Speta was treated until recently along with other blue- or mauve-flowered Hyacinthoideae with \pm free or shortly united tepals in the very broadly circumscribed genus *Scilla* L. The bulk of the sub-Saharan species were later transferred to the genus *Ledebouria* Roth (Jessop 1970), and the remaining species have now been removed to the genera *Merwillia* Speta, *Pseudoprospéro* Speta and *Schizocarphus* Van der Merwe (Speta 1998) following the application of molecular techniques in conjunction with morphological and karyological studies. A recent phylogenetic analysis of the family based on the plastid genome (Manning *et al.* 2004) placed *Merwillia* and *Schizocarphus* within a monophyletic sub-Saharan clade of subfamily Hyacinthoideae but the position of *Pseudoprospéro* was incompletely resolved as one element of a trichotomy which included the sub-Saharan tribe Massonieae Baker and the Eurasian tribe Hyacintheae Dumort. *Pseudoprospéro* thus occupies a significant position in the radiation and biogeography of the subfamily, having diverged near the split between the Eurasian and the sub-Saharan taxa. Chemotaxonomic studies of *Pseudoprospéro* bulbs from the Grahamstown District (Koorbanally *et al.* 2007) did not reveal any significant new chemical subclasses to reinforce the circumscription of Pseudoprosperaeae but five novel 3-hydroxy-3-benzyl-4-chromanones were isolated. Subsequent phytochemical investigation of *P. firmifolium* material recently collected around Durban has currently resulted in re-isola-

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tion of only two of the five compounds but also a number of other homoisoflavonoids not found in the previous analysis (D.A. Mulholland pers. comm. 2009). These findings in *Pseudoprospéro*, in conjunction with the well-documented production of homoisoflavonoids by both the Massonieae and Hyacintheae (Pohl *et al.* 2000), suggest that the capacity of the Hyacinthoideae to synthesize compounds of this class evolved prior to the divergence of the extant tribes.

***Pseudoprospéro firmifolium* (Baker) Speta** in *Phyton* 38: 116 (1998). *Scilla firmifolia* Baker: 7 (1870); Van der Merwe: 296 (1944); Jessop: 241 (1970). Type: South Africa, [Eastern Cape], Albany Div., New Years River, November without year, *MacOwan* 461 [K, lecto!., designated by Jessop: 241 (1970); GRA, iso!].

Deciduous geophyte. *Bulb* tunicated, clump-forming, \pm hypogaeal, ovoid or subglobose, 200–400 mm diam.; outer tunics becoming papery and greyish brown from tips otherwise green where exposed, sometimes forming short, loose, papery collar, inner tunics tightly overlapping, whitish. *Leaves* 6–8 in flowering plants, becoming progressively smaller and narrower towards centre, suberect or arching, lanceolate-attenuate, mostly 100–150 \times (2–) 5–12(–16) mm, canaliculate, margins narrowly hyaline and minutely denticulate, bright green and softly leathery when fresh. *Inflorescence* an elongated, lax raceme, simple

or with 1–few short branches from lower bracts, 20–600 mm long, many-flowered; scape suberect or sprawling, \pm 2 mm diam. at base; bracts subulate, membranous at first becoming dry and papery, lowermost up to 10 mm long but usually 4–6 \times 0.5–0.8 mm, with minute bracteole 1–2 mm long on alternate sides; pedicels suberect, 6–10(–15) mm long. *Flowers* facing upwards, unscented, white flushed pink to lilac with green or brown midrib; tepals biseriate with outer series overlapping inner at base, united basally for \pm 0.5 mm, spreading or slightly recurved from base, narrowly oblong, 3–5 \times 1–2 mm. *Stamens* adnate to perianth for \pm 1 mm, basally connate, suberect; filaments subulate, 3.0–3.5 \times 0.5 mm, white; anthers \pm 1 mm long at anthesis, reddish to purple; pollen yellow. *Ovary* turbinate, deeply 3-lobed with 2 ovules per locule, \pm 1.5 \times 1.5 mm, either yellowish green with pure white style, or purple with basal half or entire style also purple; style slender and tapering to small terminal stigma, 2.0–2.5 mm long, slightly 3-grooved. *Capsule* turbinate, deeply 3-lobed, 2.5–3.0 \times 3–4 mm, locules 1-seeded, dehiscing along upper half of suture only. *Seeds* ovoid, 2.5 \times 2.0 mm, dark brown, testa closely adhering, papillate-pustulate.

Pseudoprospéro was until recently considered to be confined to the Eastern Cape, between Alexandria and Umtata (Van der Merwe 1944; Jessop 1970), but the recent discovery of several populations of the species between Durban and the Tugela River in KwaZulu-Natal extends the known range of the species some 300 km to the northeast. Apart from a single early collection of the species from south of Umtata made in the first half of the nineteenth century by J.F. Drège, all other collections of the species are from a small area centred on Grahamstown. The countryside around Umtata has been transformed substantially by grazing over the past century and it is thus not altogether surprising that there are no recent collections from here but it is remarkable that the species has remained undetected for so long around Durban, a region that some (McCracken & McCracken 1990) consider to have been intensively botanized for well over a century. Several reasons probably contribute to the late discovery of the taxon in KwaZulu-Natal, not least the fact that this relatively inconspicuous plant is highly localized. Improved road access into the region has also opened up areas to botanical collectors.

Morphologically, the KwaZulu-Natal populations of *Pseudoprospéro* differ in only minor details from the Eastern Cape plants, notably in their generally broader leaves, and most conspicuously, their purple instead of yellowish green ovary. These differences appear to be consistent across the two known sets of populations. Careful searching along the edge of the coastal plateau between Durban and Umtata may yield further populations that connect the two known areas of occurrence but until then the small morphological and possible chemical differences, in combination with the rarity of the species and the apparent disjunction in distribution, provide reasons for distinguishing the KwaZulu-Natal plants as a separate subspecies.

Key to subspecies

- 1a Leaves 2–10(–15) mm wide at base; ovary yellowish green, style white subsp. *firmifolium*
- 1b Leaves (4–)6–16 mm wide at base; ovary and style purple subsp. *natalensis*

Pseudoprospéro firmifolium subsp. *firmifolium*

Distribution and ecology: thus far known only from the Eastern Cape, mainly between Alicedale and Peddie (especially around Grahamstown), with a single early record by Drège from south of Umtata (Figure 11). The southern collections between Alexandria and Peddie are uniform for flower coloration but these details are not known for the plants from Umtata. This locality lies almost midway between the bulk of the southern collections (representing the typical subspecies) and the northern ones that are treated here as subsp. *natalensis* but we place it provisionally in the typical subspecies on account of its narrow leaves. Plants form colonies among rocks in open savanna, flowering in midsummer between December and March.

Pseudoprospéro firmifolium subsp. *natalensis*

J.C.Manning, subsp. nov.

Folia ad basem (4–)6–16 mm lata, ovarium stylusque purpureum.

TYPE.—KwaZulu-Natal: 2930 (Durban): Nyuswa, below Portion 585 of the Farm Assagay Kraal, Botha's Hill, (–DD), 23 December 2007, *Styles* 3308 (NH, holo.; K, NBG, NU, MO, PRE, iso.).

Distribution and ecology: apparently restricted to a small area of KwaZulu-Natal (Figure 11), where it is known from three localities along the edge of the coastal plateau between the Umgeni (Mgeni) and Tugela (Thukela) River valleys, a distance of \pm 80 km. At the type locality, where the species is most abundant, plants grow in shallow

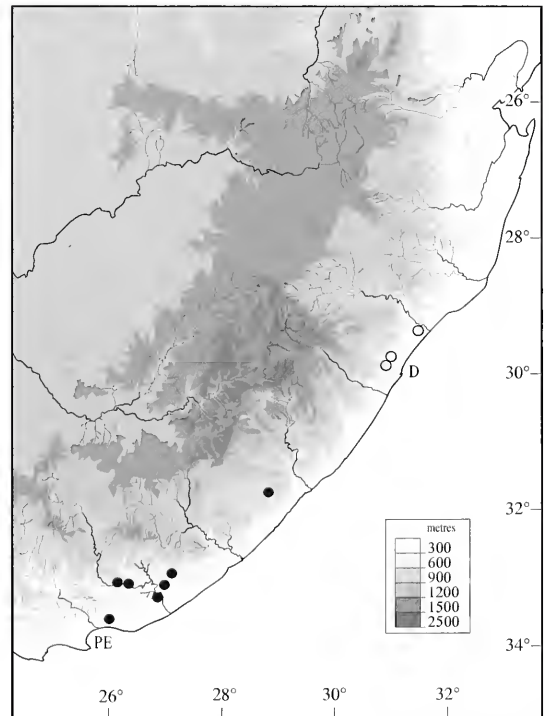


FIGURE 11.—Known distribution of *Pseudoprospéro firmifolium* subsp. *firmifolium*, ○; subsp. *natalensis*, ●.

soils fringing exposed granite sheets, whereas at the other localities they occur in soil where the substrate is not rocky. All localities are, however, situated within Eastern Valley Bushveld (Mucina & Rutherford 2006). Plants may occur in exposed situations or in partial shade among trees and shrubs where there is no closed canopy. Flowering takes place in midsummer, from December to February.

Although Eastern Valley Bushveld as a vegetation type is considered Least Threatened by Mucina & Rutherford (2006), all populations of *Pseudoprospero firmifolium* subsp. *natalensis* found to date face some degree of threat. The population at the type locality is threatened by proximate peri-urban sprawl which has already resulted in some degradation of the surrounding vegetation. This is exacerbated by cattle, which trample the thin soils in which the plants grow, and by alien plant invasion. Moreover, a large housing development has been proposed on land above the population, with the potential to greatly increase storm water flows down the granite sheets on which the plants occur.

Plants of the other known population in the Durban area are very localized, occurring within a small area ($\pm 200 \text{ m}^2$) in a fragment of untransformed Eastern Valley Bushveld on the shores of the Inanda Dam. Once one of the largest natural areas left within the city, development of roads in this area has resulted in extensive settlement and ongoing removal of the natural vegetation.

One of the localities, along the south bank of the Tugela River, was subsequently destroyed by construction of a road. Unlike the greater Durban area, where much of the remaining Eastern Valley Bushveld will likely be degraded or transformed in future, there are nonetheless many inaccessible valleys along the Tugela River which are likely to remain as they are for some time to come. It is not unreasonable to assume that other populations could occur in these.

Additional material examined

subsp. *firmifolium*

EASTERN CAPE.—3128 (Umtata): between Morley and Umtata, (–DD), February 1832, *Drège 4492* (K). 3326 (Grahamstown): Alexandria, Bushman's River Poort, (–AC), 5 January 1956, *Archibald 6156* (PRE); Bathurst, $\frac{1}{2}$ mile [0.8 km] S of Kaffir Drift, (–AC), 21 January 1936, *Dyer 3374* (NBG, NH, PRE); Kaffir Drift, (–AC), 4 February 1970, *Bayliss 25/65* (NBG); near Salem, (–AD), 30 December 1947, *Britten s.n.* (PRE); Howieson's Poort, (–BC), 18 January 2002, *Manning 2701* (NBG); Douglas Heights, (–BC), 22 March 1967, *Bayliss 3978* (NBG); Round Hill, Lower Albany, (–BD), December 1885, *Bolus 2869* (BOL, PRE); Hopewell, (–BD), 28 December 1944, *Acocks 11058* (PRE); Trappes Valley, (–BD), 19 December 1965,

Bayliss 3081 (NBG); Alexandria, (–CB), 16 February 1943, *Holland s.n. NBG122/32* (NBG); Bathurst, (–DB), January 1957, *Sidley 3067* (PRE). 3327 (Peddie): Line Drift, Peddie, (–AA), December 1900, *Sim 4060* (PRE); Albany District, between Kaffir Drift and Trappes Valley, (–AC), 30 December 1964, *Leach & Bayliss 12631* (PRE).

subsp. *natalensis*

KWAZULU-NATAL.—2930 (Pietermaritzburg): close to Inanda Dam, inland of Durban, (–DB), 2005 fl. in cult. 8 January 2007, *Styles 3307* (NH); Botha's Hill, below Portion 585 of the Farm Assagay Kraal, 465 m, (–DA), 14 December 2008, *Crouch 1184* (NH). 2931 (Stanger): Mabhobhane, near Mapumulo, south bank of Tugela River, (–AA), 8 January 2007, *Styles 3306* (NH, NBG, NU).

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HYACINTHACEAE

A NEW SPECIES OF *DRIMIA* (URGINEOIDEAE) FROM THE KNERSVLAKTE, WESTERN CAPE, SOUTH AFRICA

INTRODUCTION

Drimia Jacq., as broadly circumscribed by Manning *et al.* (2004), comprises ± 100 species, many of which belonged to the 11 genera previously placed in the subfamily Urgineoideae by Speta (1998). Consisting entirely of bulbous, mostly deciduous plants, the genus is known from southern Africa through tropical Africa to the

Mediterranean, Asia and Madagascar. Species of *Drimia* have short-lived flowers with the tepals \pm united at the base (Manning *et al.* 2004) and, like all representatives of Urgineoideae, the inflorescence has small bracts of which the lower ones at least are spurred. Although this broad treatment is more inclusive than those of Jessop (1977) and Stedje (1987, 1996), all agree on the inclusion of *Urginea* Steinh. in *Drimia*.

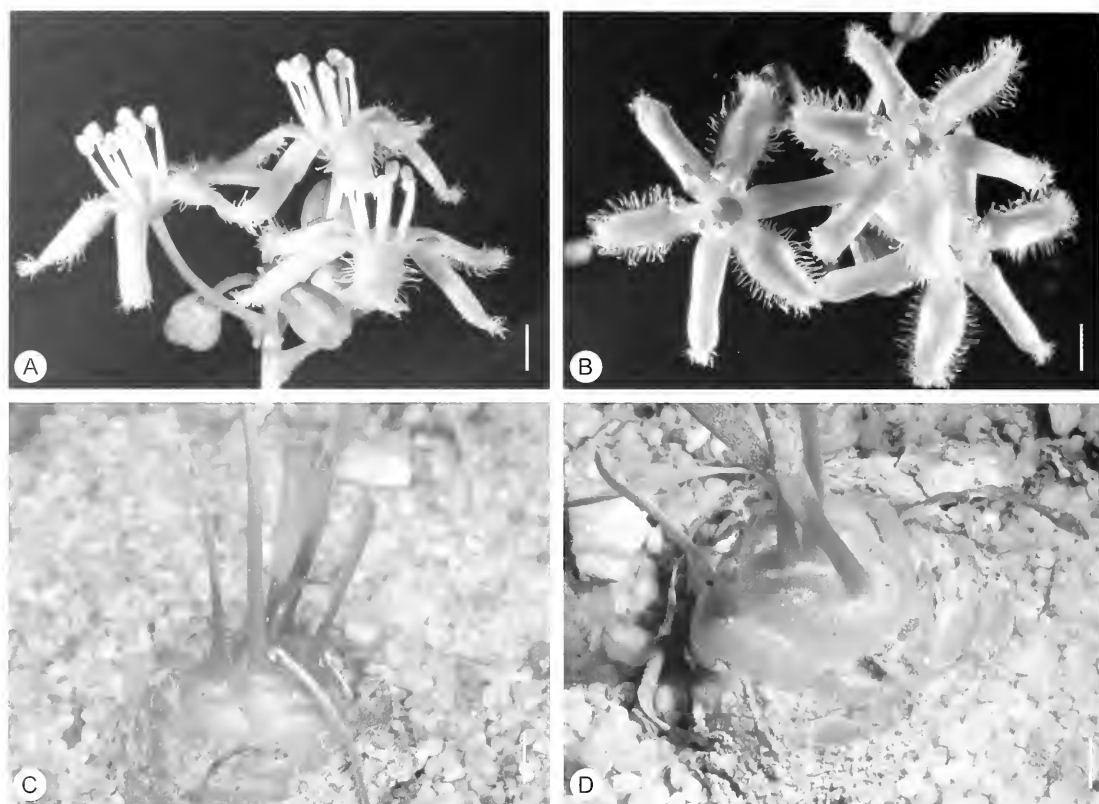


FIGURE 12.—Macromorphology of *Drimia fimbrimarginata*, Harrower 2762 (NBG, PRE). A, lateral view of flowers; B, frontal view of flowers; C, epigeal bulb with mature leaves showing the abscission from bulb scales; D, bulb showing imbricate bulb scales. Scale bars: A, B, 3 mm; C, D, 5 mm. Photographs: A,D. Harrower.

In the last six years, four new *Drimia* species have been described from the winter rainfall region of the Northern and Western Cape Provinces, South Africa (Manning & Goldblatt 2003, 2007), all in the *Urginea* group as recognized by Goldblatt & Manning (2000). All are hysteroanthous-leaved species, characterized by contracted, \pm capitate inflorescences and campanulate flowers with spreading tepals. Their late discovery in the relatively well-explored Greater Cape Floristic Region, *sensu* Born *et al.* (2006), is likely due to the growth habit of these species which is marked by a long dormant phase. This is broken only by the appearance in winter of the leaves, which decay at the end of spring, and by the brief flowering of the bulbs in summer.

We report here on the discovery of another member of the *Urginea* group from the winter rainfall region. This remarkable new species, known only from one collection on the quartz-strewn plains of the Knersvlakte, Western Cape Province, is a dwarf plant with distinctive flowers and leaves and is named *Drimia fimbrimarginata* to describe the flower's conspicuously fringed inner tepals, a character never before known in the genus.

***Drimia fimbrimarginata* Snijman, sp. nov.**

Geophytum deciduum, foliis \pm 8, fere hysteroanthus effusis lanceolatis, $12-26 \times \pm 1.5$ mm, adaxialiter trichomatibus minutis reflexis munitis; scapo flexuoso, $25-55 \times 0.7$ mm longo, racemo dense 6 vel 7-floro; bracteis

$0.5-1.5$ mm longis, inferioribus calcaribus $0.8-1.0$ mm longo munitis; floribus campanulatis; pedicellis suberectis, $5-8$ mm longis; tepalis ± 7.0 mm longis, basin versus in tubum cupulatum ± 1.5 mm longum connatis, exterioribus 1.5 mm latis, apice ciliatis, interioribus 2 mm latis, apice et in lateribus ciliatis; ciliis albis, 1 mm longis; staminibus erectis, per ± 1 mm ad perianthium adnatis; filamentis erectis, subteretibus, sursum decrescentibus, ± 4 mm longis; antheris dorsifixis, ± 1.2 mm longis; ovario ovoideo, ad $\pm 2.5 \times 2.0$ mm; stylo ± 2.5 mm longo.

TYPE.—Western Cape: 3118 (Vanrhynsdorp), Knersvlakte, Farm Moedverloor, ± 17 km NE of Koekenaap, (–AD), on quartzite ridges, 22 July 2005, *A.D. Harrower* 2762 (NBG, holo.; PRE, iso.).

Deciduous, bulbous herb, up to ± 60 mm tall at flowering. *Bulb* solitary, half-epigeal during growing season, subglobose, $20-22$ mm diam.; scales tightly imbricate, \pm spiralled, basally vaginate, fleshy, buff-coloured. *Leaves* mostly dry and shed at flowering, ± 8 , spreading at first, becoming suberect later in growing season shortly before dormancy, inserted far apart on apex of inner bulb scales in a sparse tuft, abscising abruptly from apex of scales; blade narrowly lanceolate, $12-26 \times \pm 1.5$ mm, narrowed to ± 1 mm near base, firm, olive-green; adaxial surface plane, with pale sheen from minute, whitish, thick, recurved trichomes arranged in vertical rows, with each trichome inserted on a minute green papilla;

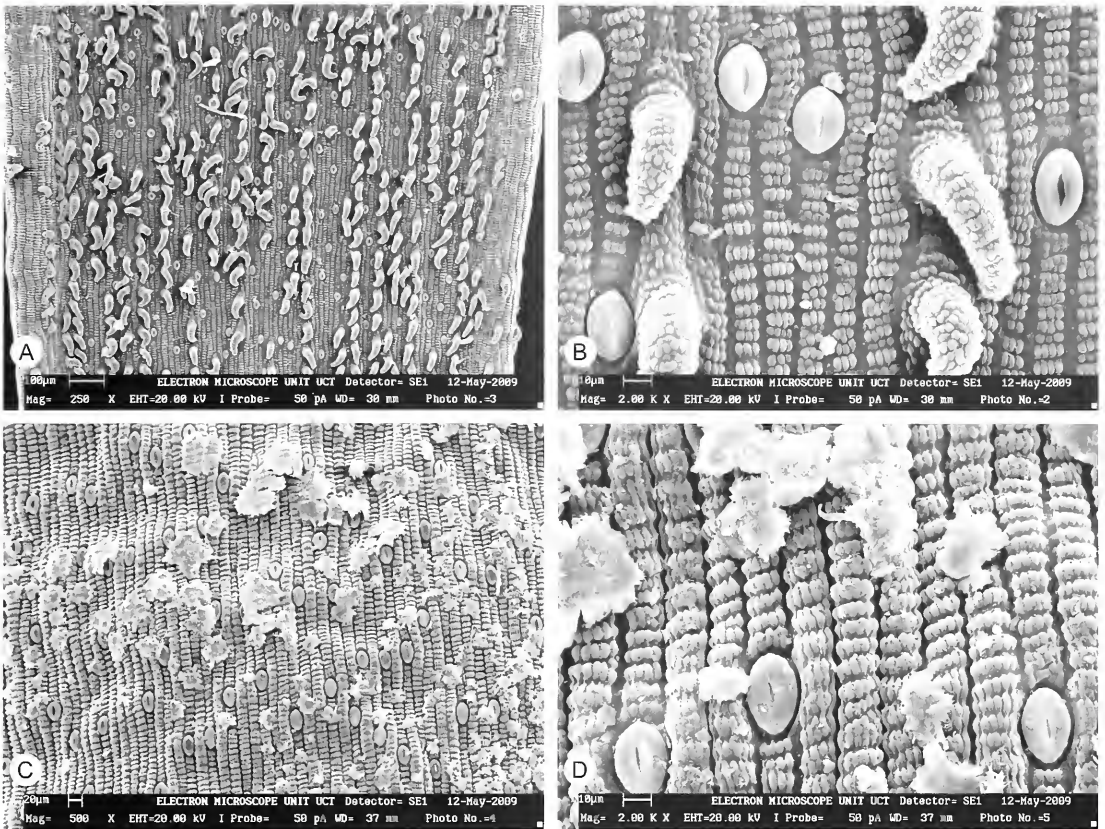


FIGURE 13.—Scanning electron micrographs of leaves of *Drinia finbrimarginata*, Harrower 2762 (NBG, PRE). A, adaxial leaf surface showing difference between leaf margin and inner part of blade; B, adaxial leaf surface showing recurved trichomes, sunken stomata with thick-walled guard cells, and axially elongated epidermal cells bearing parallel clusters of micropapillae; C, D, abaxial leaf surface showing sunken stomata and \pm striate epidermal cells with parallel clusters of micropapillae. Scale bars: A, 100 μ m; B, D, 10 μ m; C, 20 μ m.

abaxial surface slightly convex in t/s, smooth, slightly thicker towards base, minutely glaucous distally; margin \pm smooth, minutely thickened and translucent; epidermal cells of both surfaces elongated, with straight anticlinal walls and sunken cell borders, those of adaxial surface bearing parallel clusters of 3 or 4 micropapillae, those of abaxial surface \pm longitudinally striate and bearing parallel clusters of 5 or 6 micropapillae; stomata on both surfaces anomocytic, sunken, and with thick-walled guard cells; wax platelets with crenulated margins sparsely covering abaxial surface in distal half. *Inflorescence* a solitary, simple, bracteate raceme; scape flexuose, slender, 25–55 \times 0.7 mm, brownish green, sparsely puberulous for most of length, becoming smooth close to flower cluster, hairs \pm in vertical rows, minute, spreading to slightly reflexed; raceme corymbose, densely 6 or 7-flowered; bracts 0.5–1.5 mm long, lower spurred, except uppermost ones, with spur 0.8–1.0 mm long. *Flowers* suberect, shallowly campanulate, 1–3 open simultaneously, white to pale beige above, backed with darker beige and slightly tinged with pale green, opening at \pm 16:00 and closing at \pm 20:30, unscented; pedicels curved upwards, 5–8 mm long at anthesis, brownish green; tepals biseriate, fused basally for \pm 1.5 mm into shallow cup, free and spreading to slightly arched above, \pm 7.0 mm long, outer tepals oblong, \pm 1.5 mm wide, tipped with tuft of \pm 1 mm long, fine, white hairs, inner

tepals narrowly ovate, \pm 2 mm wide, fringed with 1 mm long, fine, white hairs except basally. *Stamens* adnate to base of tepals for \pm 1 mm; filaments suberect, subterete, tapering distally, \pm 4 mm long, white; anthers erect, dorsifixed, introrse, dehiscent by longitudinal slits, \pm 1.2 mm long, yellow, with yellow pollen. *Ovary* ovoid, \pm 2.5 \times 2.0 mm, green; style columnar, \pm 2.5 mm long, white, widening to a truncate, trigonous, minutely papillate, stigmatic apex. *Capsule* and *seeds* unknown. *Flowering time*: late November to early December. Figures 12; 13.

Distribution and ecology: the species is currently known from a single population on the quartz fields of the western Knersvlakte, on the Farm Moedverloor, NE of Koekenaap (Figure 14), in Knersvlakte Quartz Vygieveld (Mucina & Rutherford 2006). The habitat comprises dry, undulating, shale-derived, clay hills covered by a prominent layer of weathered, white quartz pebbles. On N-facing slopes, below a large quartzitic outcrop, the population is confined to a ridge covered with less-eroded, more stable quartz pebbles than those found on the surrounding hills. Winter temperatures in the area are mild, but summer temperatures are high (30°–35° C), moderated only by the reflective properties of the quartz. When first collected in July 2005, the plants were in leaf, but they flowered in late November and early December, after being cultivated in the potted

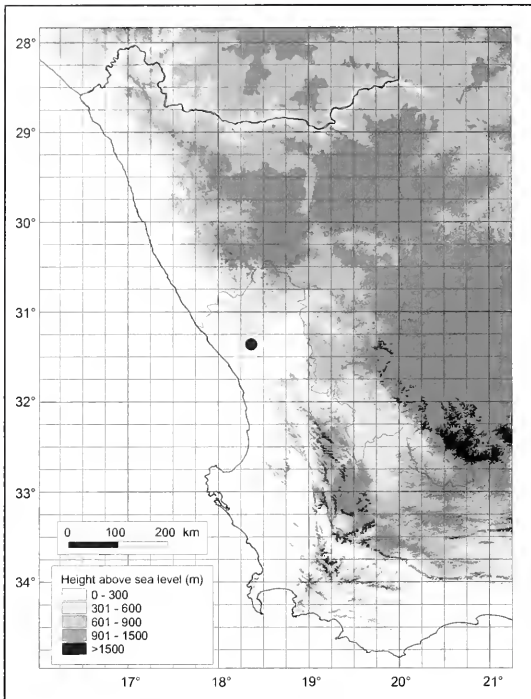


FIGURE 14.—Distribution of *Drimia fimbrimarginata* in Western Cape Province.

collections at the Kirstenbosch National Botanical Garden. Apart from keeping the bulbs dry in summer, they seem not to require any specific growing conditions, as the collection flowered well in the subsequent two years of cultivation. Despite hand pollination, no fruit was produced which suggests that individuals are self-incompatible and require outcrossing. Since the plants are yet to be seen flowering in the wild, their pollination biology remains unknown.

Despite an intensive search in the surrounding areas, only one population of *Drimia fimbrimarginata* is known. The occurrence, however, of a small number of plants in only a few suitable places is a feature of many species endemic to the Knersvlakte. Other quartz-loving, geophytic species endemic to the western Knersvlakte are *Bulbine dactyloposides* G.Will., *B. haworthioides* B.Nord., *Lachenalia patula* Jacq., *Ornithogalum naviculum* W.F.Barker, and *Othonna hualii* B.Nord.

Diagnosis and relationships: *Drimia fimbrimarginata* is allied to a group of species, mainly from the Greater Cape Floristic Region (Born *et al.* 2006), which share \pm capitate inflorescences and shallowly campanulate, brownish to brownish white flowers with \pm spreading tepals. Originally Jessop (1977) recognized just two species as having these features: *D. depressa* (Baker) Jessop and *D. marginata* (Thunb.) Jessop. But recently, Brink & Dold (2003) and Manning & Goldblatt (2003, 2007) have added six more species to the group, namely *D. acarophylla* E.Brink & A.P.Dold, *D. barkeriae* J.C.Manning & Goldblatt, *D. ligulata* J.C.Manning & Goldblatt, *D. pulchromarginata* J.C.Manning & Goldblatt, *D. vermiformis* J.C.Manning & Goldblatt, and *D.*

virens Schltr. All have remarkably uniform flowers and are distinguished from each other by the form, number, position and vestiture of their leaves.

Drimia fimbrimarginata is unusual in the *Urginea* group in having both distinctive foliage and flowers. The leaves bear minute, pale, recurved trichomes in vertical rows on the adaxial surface, giving the olive-green blades a whitish sheen. Uniquely in the genus, the flowers have markedly different outer and inner tepals. The outer ones are oblong and tipped with a prominent tuft of soft, white hairs (\pm 1 mm long), whereas the inner tepals are narrowly ovate and fringed with \pm 1 mm long, fine, white hairs, except near the base. The flowers are small and remain open for about four hours from the late afternoon to early evening. Being unscented they are not typical moth-flowers. The unique, white fringing of the inner tepals may, however, play a role in attracting pollinators that are active at dusk.

From morphological data alone, it is difficult to know which species in the *Urginea* group is most closely allied to *Drimia fimbrimarginata*. It is noteworthy, nevertheless, that *D. barkeriae* which occurs on the flats surrounding the Piketberg, Western Cape, occupies the fringe of quartzite pebble fields that support Piketberg Quartz Succulent Shrubland, a vegetation unit that forms part of the Knersvlakte Bioregion, as classified by Mucina & Rutherford (2006). Since *D. fimbrimarginata* occupies similar quartz-strewn patches further north in the Knersvlakte Bioregion, it is conceivable that these two species share a recent common ancestor that diversified when new quartz-field habitats developed during the geomorphic evolution and aridification of the forelands along the Cape's West Coast. *Drimia barkeriae* differs from *D. fimbrimarginata* by having a tuft of obovate leaves that are \pm conspicuously hairy beneath and an inflorescence of brownish, smooth-tepalled flowers that open in the late morning and fade in the evening.

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POACEAE

A NEW SUBSPECIES OF *TRICHONEURA ELEUSINOIDES* AND TWO NEW SPECIES OF *PANICUM* FROM SOUTH AFRICA

ERAGROSTIDEAE

The first record in PRE (*Obermeyer, Schweickerdt & Verdoorn* 309) of the new taxon, *Trichoneura eleusinoides* (Rendle) Ekman subsp. *limpopoensis*, was collected in November 1932 on the Farm Zoutpan in Limpopo Province. Subsequently, mainly during the months of January to April, more specimens of this taxon were gathered by various collectors from the Farm Breslau in the west to Punda Maria in the east, and from areas north of the Soutpansberg, i.e. from the northern slopes of the mountain range, to the Limpopo River. The taxon was first identified as *T. schlechteri* Ekman, but this is a coastal grassland plant known only from Mozambique and differs in having a glabrous palea (Cope 1999). Chippindall (1956) already indicated that this was a misidentification, and in Gibbs Russell *et al.* (1990) this species was referred to as *Trichoneura* sp. = *Codd* 5325.

Apart from its distribution and the longer spikelet, lemma, caryopsis and anthers, the misidentified species closely resembles *Trichoneura eleusinoides* which occurs in the western, central and northwestern regions of Namibia and into Angola. The height of *T. eleusinoides* ranges from 100–300 mm in the south and gradually increases to \pm 700 mm in Angola, but the spikelet characters remain the same throughout the distribution area. As the only difference between the two taxa is their distribution area and the size of the spikelets (5–11 mm compared to 3–4 mm) and their components, the new taxon is best regarded as a subspecies of *T. eleusinoides* until more in-depth studies are done.

Trichoneura eleusinoides* (Rendle) Ekman subsp. *limpopoensis L.Fish, subsp. nov., subspecies typicae valde similis sed spicula, lemmate, antheris, caryopsid-eque longioribus et in provincia Limpopo disposita.

Trichoneura sp. (= *Codd* 5325) in Gibbs Russell *et al.*: 344 (1990).

TYPE.—Limpopo, 2229 (Waterpoort): Masekwa Poort, (–DD), *Ellis* 1945 (PRE, holo.).

Tufted annual, possibly biennial, 300–700 mm high; lower sheaths light brown, occasionally flushed purple; leaves mostly cauline. Culms slender, erect, sometimes geniculate; nodes dark. Leaf blades up to 150 × 2.0–6.5

mm, lanceolate, acute, flat, glabrous or with sparsely scattered, long, thin, bulbous-based hairs; margin scabrid. Leaf sheaths with long, slender, bulbous-based hairs, bases often red. Inflorescence 60–200 mm long; racemes 10–20, up to 60 mm long, becoming shorter towards apex, ascending, not spreading more than 45° from central axis; spikelets crowded, less than own length apart. Spikelet 5.5–7.5(–8.0) mm long (including awn), disarticulating above glumes and between florets. Glumes 5–8 mm long (including awn), tapering to an awn, unequal, slightly shorter to as long as to sometimes longer than spikelet, awn up to 1 mm long. Florets many, decreasing in size upwards. Lemma 2.8–3.0 × 0.8–1.0 mm, apex membranous; lateral nerves densely long-hairy, middle of back hairy from base to $\frac{3}{4}$ up; awn 0.8–1.2 mm long, shorter than body of lemma. Palea as long as lemma, apex emarginate, capitate, pilose, upper margins and apex minutely ciliate. Anthers 0.6–1.0 mm long. Caryopsis 2.0–2.5 × 0.5 mm, oblong. Flowering time: January to May (occasionally November). Figure 15.

Distribution and habitat: recorded in the far west on the Limpopo on the farms Breslau and Greefswald, then on the northern slopes of the Soutpansberg, in the west from Zoutpan eastwards to around Wylliespoort and then again in the extreme east in the Kruger National Park around Punda Maria and the Dzundwenia Hills on sandy to sandy loam soils often derived from quartzite, on rock slabs, in rocky depression or ledges and crevices on rocky or stony slopes or moist soils on banks of rivers or streams. Figure 16.

Etymology: the subspecific epithet *limpopoensis* refers to the geographical region where the taxon grows.

Other specimens examined (all housed in PRE)

LIMPOPO.—2229 (Waterpoort): Farm Greefswald 615, (–AB), *Codd* 4123, *Theron* 2954, *Mothogoane* 316; Farm Breslau, (–AC) *Straub* 937; Zoutpan, (–CD), *Schweickerdt & Verdoorn* 609; Waterpoort, Van Colliers Pass, (–DC), *Smook* 5399; Wylliespoort, (–DD), *De Winter & Codd* 334; Masekwa Poort, *Ellis* 1946, 2231 (Pafuri); Punda Maria, (–CA), *Van Oudtshoorn* PRE62830; Dzundwenia Hills, (–CC), *Codd* 5325; *Ellis* 3237.



FIGURE 15.—*T. eleusinoides* subsp. *limpopoensis*, Schweickerdt & Verdoorn 609. A, habit, $\times 0.8$; B, dorsal view of lemma, $\times 7.8$; C, lateral view of spikelet, $\times 7.8$. Artist: Gillian Condy.

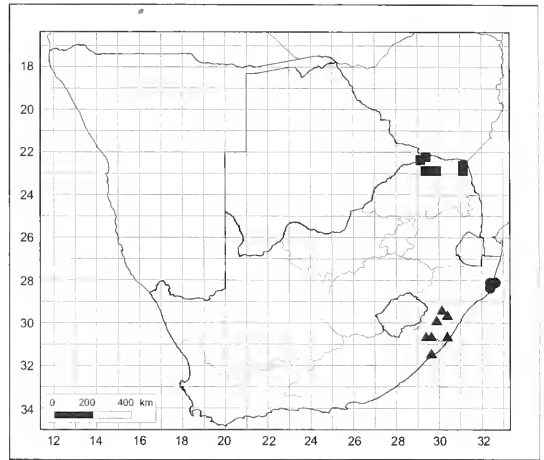


FIGURE 16.—Distribution of *T. eleusinoides* subsp. *limpopoensis*, ■; *Panicum sancta-luciense*, ●; and *P. silvestre*, ▲.

PANICOIDEAE-PANICEAE

***Panicum sancta-luciense* L.Fish, sp. nov., *P. hymenochilo* Nees similis sed robustior, flosculo infero masculo paleaque inferna bene evoluta.**

TYPE.—KwaZulu-Natal, 2832 (Mtubatuba): St Lucia Game Park, (–BA), Smook 1908 (PRE, holo.).

Trailing perennial; rooting at nodes. *Leaves* cauline, lanceolate, 30–60 \times 5–12 mm, apex acute, base cordate, amplexicaul, glabrous or hairy; margin thickened, often crinkled, usually scaberulous, bulbous-based hairs present at base. *Leaf sheaths* densely hairy with bulbous-based hairs; convolute with outer margins densely long-hairy; inner margins membranous, glabrous to hairy. *Inflorescence* an open, obovate panicle 30–110 mm long, sparsely branching; primary branches solitary or in clusters of 2 or 3 on same side of central axis, clusters alternate on central axis; nodes with thin, usually purple, hairy pulvini. *Spikelets* 1.8–2.5 mm long, apices of glumes and lemmas usually purple. *Glumes* unequal; lower glume ovate, up to $\frac{1}{2}$ as long as spikelet, 3-nerved (at least near base) rarely 1-nerved on same inflorescence; upper glume slightly shorter than lower lemma and as long as upper lemma, 9-nerved. *Florets* 2; lower floret male, lemma longer than upper floret, 9–11-nerved, at least at base; palea well developed, as long as lemma; anthers 1.3 mm long, dark yellow, flushed purple; upper floret bisexual, crustaceous, shiny, pallid to straw-coloured, apex with scattered stiff hairs. *Flowering time*: January to April. Figure 17.

Distribution and ecology: *Panicum sancta-luciense*, so far only recorded for the Greater St Lucia area, is a hygrophilous grass growing between other grasses and sedges in sandy soils in moist areas and swamps, also in water deeper than 1.5 m with culms and leaves forming floating mats. Figure 16.

Etymology: the specific epithet *sancta-luciense* refers to the geographical region in which the species grows.



FIGURE 17.—*Panicum sancta-luciense*, Feeley, Tinley & Ward 22. A, habit, $\times 0.8$; B, lateral view of spikelet, $\times 8$. Artist: Gillian Condy.

Specimens examined (all housed in PRE)

KWAZULU-NATAL.—2832 (Mtubatuba): east of Fanie's Island, (–AB), Feeley; Tinley & Ward 22; Fanie's Island, De Wet 1085; between Cape Vidal and St Lucia, (–AD), Du Toit 2719; Lake Bangazi, (–BA), Ellis 3403; Lake St Lucia, eastern shores, Meersig Plantation, (–BA), Ellis 4492.

***Panicum silvestre* L.Fish, sp. nov.**, a *P. monticola* Hook.f. differt gluma inferiora 3-nervosa, et a *P. laticoma* Nees differt gluma inferiora spiculam paene aequanti usque ad hanc superanti foliisque pilis longis munitis.

TYPE.—KwaZulu-Natal, 3030—(Port Shepstone): near Mehlmnyana, (–CB), Acocks 13315 (PRE, holo.).



FIGURE 18.—*Panicum silvestre*, Moss 3812. A, habit, $\times 0.8$. B, C, spikelet: B, lower glume, $\times 7.8$; C, upper glume, $\times 7.8$. Artist: Gillian Condy.

Perennial?, scrambling; leaves cauline; culms up to 400 mm long, branched, rooting at the nodes; nodes yellow, glabrous. *Leaf sheaths* convolute, outer margins densely hairy. *Leaf blades* flat, lanceolate, 20–85 \times 4–9 mm, acuminate, base cordate, then narrowing at junction with sheath; cross-venation present (obvious on abaxial surface); long, rigid hairs present or absent; margin pale, densely scaberulous, often crinkled, usually with dense long hairs at base. *Inflorescence* a delicate, open, sparsely branched panicle, 35–145 \times 20–180 mm, closely associated with flag leaf or well exserted; branches long, fine; spikelets solitary, on long capillary pedicels up to 15 mm long and slightly thickened at apex. *Spikelets*

1.8–2.4 mm long. *Glumes* \pm equal; lower glume as long as upper glume or lower lemma, narrower than upper glume, 3-nerved, long-acuminate; upper glume longer than spikelet, 7-nerved, hardly separated from lower glume. *Florets* 2; lower floret sterile, lemma 5–7-nerved, palea absent or reduced to a small scale; upper floret bisexual, shorter than glumes (at least upper) and lower lemma, pallid to light brown, crustaceous, shiny. *Flowering time*: December–July. Figure 18.

Similar to *Panicum laticomum* Nees which has leaves glabrous or hairy with short rigid hairs and with asymmetrical base; glumes distinctly separated and lower glume $\frac{1}{2}$ as long as spikelet; and an inflorescence with many more spikelets.

Distribution and ecology: recorded from around Pietermaritzburg down to Kokstad and Port St Johns on forest floor between other herbs, along streams and roads in the forest; said to be common where growing. Figure 16.

Etymology: the specific epithet *silvestre* (from Latin: of the forest) refers to the habitat it grows in.

Specimens examined (all housed at PRE)

KWAZULU-NATAL.—2929 (Underberg): Lundie's Hill, Umkomaas Valley near Bulwer, (–DD), *Doidge* PRE57884. 2930 (Pietermaritzburg): Ehlatini, Karkloof, (–AC), *Moll* 2872; Swartzkop, near Pietermaritzburg, (–CB), *Moss* 3812; Pietermaritzburg, Chase Valley below Queen Eliza-

beth Park, (–CB), *Ellis* 4415. 3029 (Kokstad); Draal Kloof, Kokstad, (–CB), *Sidley* 547; Angeli Forest, (–DA), *Smook* 1759.

EASTERN CAPE.—3129 (Port St Johns): Ntafufu, (–DA), *Strey* 8520.

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Guide for authors to *Bothalia*

This guide is updated when necessary and includes an index. **Important points and latest additions appear in bold type.**

Bothalia is named in honour of General Louis Botha, first Premier and Minister of Agriculture of the Union of South Africa. This house journal of the South African National Biodiversity Institute (SANBI), Pretoria, is devoted to the furtherance of botanical science. The main fields covered are taxonomy, ecology, anatomy and cytology. Two parts of the journal and an index to contents, authors and subjects are published annually.

1 EDITORIAL POLICY

1.1 *Bothalia* welcomes original papers dealing with flora and vegetation of southern Africa and related subjects. Full-length papers and short notes, as well as book reviews and obituaries of botanists, are accepted. The editor should be notified that an article is part of a series of manuscripts; please submit a list of the parts of a series; all parts should preferably be published in one journal.

1.2 Submission of a manuscript to *Bothalia* implies that it has not been published previously and is not being considered for publication elsewhere.

1.3 Authors whose first language is not English are requested to have their MS edited by an English speaker before submission.

1.4 Articles are assessed by referees, both local and overseas. Authors are welcome to suggest possible referees to judge their work. Authors are responsible for the factual correctness of their contributions. *Bothalia* maintains an editorial board (see title page) to ensure that international standards are upheld.

1.5 **Page charges:** as stated in our notification included in volume 23,1 (May 1993), MSS submitted for publication in *Bothalia* are subject to payment of page charges of R125,00 per printed page, VAT included. The following are exempt from these charges: 1, SANBI members; 2, persons/institutions who have been granted exemption by the Executive Committee of the SANBI; 3, authors of contributions requested by the Editor; 4, contributors to the column 'FSA contributions'. The Editor's decision on the number of pages is final. An invoice will be sent to the author, who must arrange for payment as soon as possible to SANBI, Publications Section, Private Bag X101, Pretoria 0001.

1.6 Deadline dates for submission of MS: for possible inclusion of the MS for the May issue—**May** of the previous year, and for the October issue—**October of the previous year**.

2 REQUIREMENTS FOR A MANUSCRIPT

2.1 The original manuscript should be typed on one side of A4-size paper, double line spacing throughout (including abstract, tables, captions of figures, litera-

ture references), and have a margin of at least 30 mm all round. **Tables should be typed in single line spacing on a separate page at the end of the article.** Three photocopies (all pages photocopied on both sides of the paper, including figures, to reduce weight for postage) of all items, including text, line drawings, tables and lists should be submitted, and the author should retain a complete set of copies. **High quality photocopies** of each figure should be submitted for review purposes. **The electronic version of the text should be submitted with the manuscript.**

2.2 Papers should conform to the general style and layout of recent issues of *Bothalia* (from volume 26 onwards).

2.3 Material should be presented in the following sequence: title page with title, name(s) of author(s), **address(es) of author(s) and mention of granting agencies, keywords and abstract.**

2.4 The sequence continues with Introduction and aims, Contents (see 8), Material and methods, Results, Interpretation (Discussion), Specimens examined (in revisions and monographs), Acknowledgements, References, Index of names (recommended for revisions dealing with more than about 15 species), Tables, Captions of figures and figures. In the case of short notes, obituaries and book reviews, keywords and an abstract are **omitted**.

2.5 All pages must be numbered **i.e. typed consecutively on the top right-hand corner of the page**, beginning with the title page to those with references, tables, captions of figures and figures.

2.6 Special characters: use your own word or code that is unique and self-explanatory, enclosed between ANGLE BRACKETS, e.g. <mu>m for µm. Please supply us with a list of the codes.

2.7 Use a non-breaking space (in MS Word—Ctrl, shift, space) to keep two elements together on the same line, e.g. 3 500.

2.8 **DO NOT JUSTIFY LINES.**

2.9 Do not break words, except hyphenated words.

2.10 A **hyphen** is designated as one dash, with no space between the letter and the dash, e.g. ovate-lanceolate. See also 17.7.

2.11 An **N-dash** is typed in MS Word code (alt + 0150) or as **three** hyphens with no space between the letter and the hyphen, e.g. 2- -5 mm (typeset, it looks like this, 2–5 mm). See also 17.7.

2.12 An **M-dash** is typed in MS Word code (alt + 0151) or as **two** hyphens with no space between the letter and the hyphen, e.g. computers- -what a blessing! (typeset, it looks like this: computers—what). See also 17.7.

2.13 **Do not use a double space anywhere** between words, after commas, full stops, colons, semicolons or exclamation marks.

2.14 Use lower case x as times sign, with one space on either side of the x, e.g. 2 x 3 mm.

2.15 Use single (not double) opening and closing quotes, e.g. the so-called 'stiffy' refers to a rigid diskette. In MSWord the codes are alt + 0145 and alt + 0146.

2.16 Keys—put only three leader dots before number of taxon (with one space before and after each dot), regardless of how far or near the word is from the right margin, e.g. . . . 1. *R. ovata* (see 13.18).

3 REQUIREMENTS FOR ELECTRONIC FILES

3.1 USE NORMAL STYLE ONLY.

3.2 **Provide electronic files on CD or send via the e-mail to momberg@sanbi.org or germishuizen@sanbi.org. Three hard copies of the MS should also be POSTED to the editor.**

3.3 Data **should** be in **MSWord**. An **RTF** file is preferable because it retains the formatting.

3.4 All lines, headings, keys, etc., should start flush at the margin, therefore **NO INDENTATIONS, FOOTNOTES, TABS OR STYLES** of any kind.

3.5 In MS Word, italics and bold should be used where necessary.

3.6 Paragraphs and headings are delineated by a carriage return (ENTER) but **no indentation**.

3.7 **Graphics i.e. drawings, graphs or photographs: submit in a separate file, do not include it in the text.**

3.8 Image files with a bigger file size than **2MB** cannot be e-mailed as the SANBI has a **2MB** limitation on the network's firewall at Head Office. Files smaller than 2MB should be emailed to: **momberg@sanbi.org**. **Image files bigger than 2 MB should be provided on a CD or can be copied to the SANBI FTP site by using the following link: <ftp://ftp.sanbi.org/incoming/>. Permission needs to be obtained to copy material to the FTP site. Please contact the editor for details.**

3.9 **Provide an image file originated in Corel Draw (version 14 or lower), as a CDR file, with fonts converted to curves. Submit image files originated in other drawing programmes as encapsulated postscript files (EPS). The conversion to TIF or other file extensions will be accommodated by SANBI Graphics (see 12.2–12.4).**

3.10 If extensive changes to image files are proposed by the editor, the author will be contacted and the specific image file will have to be re-submitted after the indicated corrections have been implemented.

3.11 **Do not include tracked changes when submitting a MS on a CD or electronically.**

4 AUTHOR(S)

When there are several authors, the covering letter should indicate clearly which of them is responsible for correspondence and, if possible, telephonically available

while the article is being processed. The contact address, telephone number and email address should be mentioned if they differ from those given on the letterhead.

5 TITLE

The title should be as concise and as informative as possible. In articles dealing with taxonomy or closely related subjects, the family of the taxon under discussion (see also 13.2) should be mentioned in brackets but author citations should be omitted from plant names (see also 13.6).

6 KEYWORDS

Up to 10 keywords (or index terms) should be provided in English in alphabetical sequence. The following points should be borne in mind when selecting keywords:

6.1 Keywords should be unambiguous, internationally acceptable words and not recently coined little-known words.

6.2 They should be in a noun form and verbs should be avoided.

6.3 They should not consist of an adjective alone; adjectives should be combined with nouns.

6.4 They should not contain prepositions.

6.5 The singular form should be used for processes and properties, e.g. evaporation.

6.6 The plural form should be used for physical objects, e.g. augers.

6.7 **Location** (province and/or country); taxa (species, genus, family) and vegetation type (community, veld type, biome) should be used as keywords.

6.8 Keywords should be selected hierarchically where possible, e.g. both family and species should be included.

6.9 They should include terms used in the title.

6.10 They should answer the following questions:

6.10.1 What is the *active concept* in the document (activity, operation or process).

6.10.2 What is the *passive concept* or object of the active process (item on which the activity, operation or process takes place).

6.10.3 What is the means of accomplishment or how is the active concept achieved (technique, method, apparatus, operation or process).

6.10.4 What is the environment in which the active concept takes place (medium, location).

6.10.5 What are the independent (controlled) and dependent variables?

6.11 Questions 6.10.1 to 6.10.3 should preferably also be answered in the title.

7 ABSTRACT

7.1 An abstract of no more than 200 words should be provided. Abstracts are of great importance and should convey the essence of the article.

7.2 It should refer to the geographical area concerned and, in taxonomic articles, mention the number of taxa treated. It should not contain information not appearing in the article.

7.3 In articles dealing with taxonomy or closely related subjects all taxa from the rank of genus downwards should be accompanied by their author citations (see also 13.6).

7.4 Names of new taxa and new combinations should not be italicized but put in bold. If the article deals with too many taxa, only the important ones should be mentioned.

8 TABLE OF CONTENTS

A table of contents should be given for all articles longer than about 60 typed pages, unless they follow the strict format of a taxonomic revision.

9 ACKNOWLEDGEMENTS

Acknowledgements should be kept to the minimum compatible with the requirements of courtesy. Please give all the initials of the person(s) you are thanking.

10 LITERATURE REFERENCES

In text

10.1 Literature references in the text should be cited as follows: 'Jones & Smith (1986) stated...', or '...(Jones & Smith 1986)' or (Ellis 1988: 67) when giving a reference simply as authority for a statement. For treatment of literature references in taxonomic papers see 14.

10.2 When more than two authors are involved in the paper, use the name of the first author followed by *et al.*

10.3 When referring to more than one literature reference, they should be arranged chronologically and separated by a semicolon, e.g. (Nixon 1940; Davis 1976; Anon. 1981, 1984).

10.4 Titles of books and names of journals should preferably not be mentioned in the text. If there is good reason for doing so, they should be treated as described in 10.12 and 10.13.

10.5 Personal communications are given only in the text, not in the list of references. Please add the person's full initials to identify the person more positively, e.g. C. Boucher pers. comm.

In References at end of article

10.6 References of the same author are arranged in chronological sequence.

10.7 Where two or more references by the same author are listed in succession, the author's name is repeated with every reference, except in an obituary, where the

name of the deceased in the list of publications (not in the references) is replaced by an N-dash.

10.8 All publications referred to in the text, including those mentioned in full in the treatment of correct names in taxonomic papers, but no others, and no personal communications, are listed at the end of the manuscript under the heading References.

10.9 The references are arranged alphabetically according to authors and chronologically under each author, with a, b, c, etc. added to the year, if the author has published more than one work in a year. This sequence is retained when used in the text, irrespective of the chronology.

10.10 If an author has published both on his own and as a senior author with others, the solo publications are listed first and after that, in strict alphabetical sequence, those published with one or more other authors.

10.11 Author names are typed in **capital letters**.

10.12 Titles of journals and of books are written out in full and are italicized as follows: *Transactions of the Linnean Society of London* 5: 171–217, or *Biology and ecology of weeds*: 24.

10.13 Titles of books should be given as in *Taxonomic literature*, edn 2 by Stafleu & Cowan and names of journals as in the latest edition of *World list of scientific periodicals*.

10.14 Examples of references:

Collective book or Flora

BROWN, N.E. 1909. Asclepiadaceae. In W.T. Thiselton-Dyer, *Flora capensis* 6,2: 518–1036. Reeve, London.

CUNNINGHAM, A.B. 1994. Combining skills: participatory approaches in biodiversity conservation. In B.J. Huntley, Botanical diversity in southern Africa. *Sirelitzia* 1: 149–167. National Botanical Institute, Pretoria.

Book

DU TOIT, A.L. 1966. *Geology of South Africa*, edn 3: 10–50. S.M. Haughton (ed.). Oliver & Boyd, London.

HUTCHINSON, J. 1946. *A botanist in southern Africa*: 69. Gawthorn, London.

Journal

DAVIS, G. 1988. Description of a proteoid-restioid stand in Mesic Mountain Fynbos of the southwestern Cape and some aspects of its ecology. *Bothalia* 18: 279–287.

SMOOK, L. & GIBBS RUSSELL, G.E. 1985. Poaceae. *Memoirs of the Botanical Survey of South Africa* No. 51: 45–70.

STEBBINS, G.L. Jr. 1952. Aridity as a stimulus to plant evolution. *American Naturalist* 86: 35–44.

In press, in preparation

TAYLOR, H.C. in press. *A reconnaissance of the vegetation of Rooiberg State Forest*. Technical Bulletin, Department of Forestry.

VOGEL, J.C. 1982. *The age of the the Kuiseb river silt terrace at Homeb. Palaeoecology of Africa* 15. In press.

WEISSER, P.J., GARLAND, J.F. & DREWS, B.K. in prep. Dune advancement 1937–1977 and preliminary vegetation succession chronology at Mlalazi Nature Reserve, Natal, South Africa. *Bothalia*.

Thesis

KRUGER, F.J. 1974. *The physiography and plant communities of the Jakkalsrivier Catchment*. M.Sc. (Forestry) thesis, University of Stellenbosch.

MUNDAY, J. 1980. *The genus Monechma Hochst. (Acanthaceae tribe Justiciae) in southern Africa*. M.Sc. thesis, University of the Witwatersrand, Johannesburg.

Miscellaneous paper, report, unpublished article, technical note, congress proceedings

ANON. no date. *Eetbare plante van die Wolkberg*. Botanical Research Unit, Grahamstown. Unpublished.

BAWDEN, M.G. & CARROL, D.M. 1968. *The land resources of Lesotho*. Land Resources Study No. 3, Land Resources Division, Directorate of Overseas Surveys, Tolworth.

BOUCHER, C. 1981. Contributions of the Botanical Research Institute. In A.E.F. Heydom, *Proceedings of workshop research in Cape estuaries*: 105–107. National Research Institute for Oceanology, CSIR, Stellenbosch.

NATIONAL BUILDING RESEARCH INSTITUTE 1959. *Report of the committee on the protection of building timbers in South Africa against termites, woodboring beetles and fungi*, edn 2. CSIR Research Report No. 169.

11 TABLES (also electronic submissions)

11.1 Each table should be presented on a separate sheet and be assigned an Arabic numeral, i.e. the first table mentioned in the text is marked 'Table 1'.

11.2 In the captions of tables the word 'TABLE' is written in capital letters. See recent numbers of *Bothalia* for the format required.

11.3 Avoid vertical lines, if at all possible. Tables can often be reduced in width by interchanging primary horizontal and vertical heads.

12 FIGURES (original or electronic submissions)

12.1 **Line drawings (original artwork) should be in jet-black Indian ink, on fine art paper, 200 gsm. Lines should be clear enough to accommodate reduction. Do not use draughtman's film as it causes problems with the scanning process.**

12.2 **Drawings in pencil will not be accepted.**

12.3 **Provide original drawings electronically as bitmap TIF files, 600 dpi or higher. Provide photographs electronically as either TIF or JPG files, 600 dpi or higher. At the request of the Author, the Publications Section of SANBI will assist with the scanning of original material. Figures should be planned to fit, after reduction, into a width of either 80, 118 or 165 mm, with a maximum vertical length of 230 mm. Allow space for the caption in the case of figures that will occupy a whole page.**

12.4 **Graphs and histograms should be submitted as stipulated in 3.9, or as TIF or JPG files at a resolution of 600 dpi or higher if generated in other programmes. Graphs and histograms generated in EXCEL or MSWord, should be provided as is. File conversion into the correct format will be accommodated**

by SANBI Graphics. Please do not supply embedded graphics in the documents or files that are optimized for screen use. Do not submit graphs and histograms in colour. If shading is used it should be easily discernible.

12.5 Photographs should be of excellent quality on glossy paper with clear detail and moderate contrast so that the figures can be scanned without retouching them electronically. If submitted electronically, provide as a TIF or JPG file at 600 dpi or higher and **not as a DOC, PDF, EXCEL or POWERPOINT file.**

12.6 **Photograph mosaics should be submitted as separate photographs or TIF/JPG files at 600 dpi or higher, as well as a photocopy/layout of the mosaic. Final layout of the mosaic will be done by our graphics department.**

12.7 **Do not number the original images but include a scale bar. Indicate the lettering on the photocopy and not on the original image or electronic copy.**

12.8 If several illustrations are treated as components of a single composite figure they should be designated by capital letters.

12.9 Note that the word 'Figure' should be written out in full, both in the text and the captions and should begin with a capital 'F' (but see 14.7 for taxonomic papers).

12.10 In the text the figure reference is then written as in the following example: 'The stamens (Figure 4A, B) are...'

12.11 In captions, 'FIGURE' is written in capital letters.

12.12 Scale bars or scale lines should be used on figures.

12.13 In figures accompanying taxonomic papers, voucher specimens should be given in the relevant caption.

12.14 Figures are numbered consecutively with Arabic numerals in the order they are referred to in the text. These numbers, as well as the author's name and an indication of the top of the figure, must be written in soft pencil on the back of all figures.

12.15 Captions of figures **should not** be pasted under the photograph or drawing and **should also not** be included in any electronic version of the figures.

12.16 Captions of figures should be collected together and typed at the end of the MS and headed *Captions for figures*.

12.17 Authors should indicate in pencil in the text where they would like the figures to appear.

12.18 Authors wishing to have the originals of figures returned must inform the editor in the original covering letter and must mark each original 'To be returned to author'.

12.19 Authors wishing to use illustrations already published elsewhere must obtain written permission before submitting the manuscript and inform the editor of this fact.

12.20 It is strongly recommended that taxonomic articles include dot maps as figures to show the distribution of taxa. **Maps will be reduced to column width (80 mm): the symbols and numbers used must be large enough to stand reduction. The maps should show: numbered grid lines of latitude and longitude; the provinces of South Africa; and a scale line. Maps of neighbouring countries should be treated in the same way, with bordering states clearly labelled. For orientation purposes, a small inset map should appear in a corner of the figure.**

12.21 ArcView GIS maps are acceptable. The layout representing all the appropriate themes (including grid lines) should be **submitted as an encapsulated post-script file (EPS).**

12.22 Colour figures are permitted only if: a) it will clarify the article and b) the cost of reproduction and printing is borne by the author.

12.23 **Magnification of figures in the caption should be given for the size as submitted.**

13 TEXT

13.1 As a rule, authors should use the plant names (but not of all authors of plant names—see 13.6) as listed in PRECIS (National Herbarium **PRE**toria Computerised Information System).

13.2 Names of genera and infrageneric taxa are usually italicized, with the author citation (where relevant; see 13.6) not italicized. Exceptions include names of new taxa in the abstract, correct names given in the synopsis or in paragraphs on species excluded from a given supraspecific group in taxonomic articles; in checklists and in indices, where the position is reversed, correct names are not italicized and synonyms are italicized.

13.3 Names above generic level are not italicized.

13.4 In articles dealing with taxonomy, the complete scientific name of a plant (with author citation) should be given at the first mention in the text. The generic name should be abbreviated to the initial thereafter, except where intervening references to other genera with the same initial could cause confusion (see 16.6).

13.5 In normal text, Latin words are italicized, but in the synopsis of a species, Latin words such as *nom. nud.* and *et al.* are not italicized (see 16.4, 17.2).

13.6 In accordance with Garnock-Jones & Webb (1996) in *Taxon* 45: 285, 286, authors of plant names are not to be added to plant names except in taxonomic papers. Names of authors of plant names should agree with the list published by the Royal Botanic Gardens, Kew, entitled, *Authors of plant names*, edited by R.K. Brummitt & C.E. Powell (1992).

13.7 Modern authors not included in the list should use their full name and initials when publishing new plant names. Other author names not in the list should be in agreement with the recommendations of the Code.

13.8 Names of authors of publications are written out in full, without initials, except in the synonymy in taxonomic articles where they are treated like names of authors of plant names.

13.9 Names of plant collectors are italicized whenever they are linked to the number of a specimen. The collection number is also italicized, e.g. *Acocks 14407*.

13.10 Surnames beginning with 'De', 'Du' or 'Van' begin with a capital letter unless preceded by an initial.

13.11 For measurements use only units of the International System of Units (SI). **In taxonomic papers only mm and m, should be used; in ecological papers cm or m should be used.**

13.12 The use of '±' is preferred to c. or ca (see 17.8).

13.13 Numbers 'one' to 'nine' are spelt out in normal text, and from 10 onwards they are written in Arabic numerals.

13.14 In descriptions of plants, numerals are used throughout. Write 2.0–4.5 (not 2–4.5) and 2.0–4.5 × 6–9. When counting members write 2 or 3 (not 2–3), but 2–4.

13.15 Abbreviations should be used sparingly but consistently. No full stops are placed after abbreviations ending with the last letter of the full word (e.g. edition = edn; editor = ed.); after units of measure; after compass directions; after herbarium designations; after countries, e.g. USA and after well-known institutions, e.g. CSIR.

13.16 Apart from multi-access keys, indented keys should be used with couplets numbered 1a–1b, 2a–2b, etc. (without full stops thereafter).

13.17 Keys consisting of a single couplet have no numbering.

13.18 Manuscripts of keys should be presented as in the following example:

1a Leaves closely arranged on elongated stem; a submerged aquatic with only capitula exerted . . . 1b. *E. setaceum* var. *pumilum*

1b Leaves in basal rosettes; stems suppressed; small marsh plants, ruderals or rarely aquatics:

2a Annuals, small, fast-growing pioneers, dying when habitat dries up; capitula without coarse white setae; receptacles cylindrical:

3a Anthers white . . . 2. *E. cinereum*

3b Anthers black . . . 3. *E. nigrum*

2b Perennials, more robust plants; capitula sparsely to densely covered with short setae:

13.19 Herbarium voucher specimens should be referred to wherever possible, not only in taxonomic articles.

13.20 The word Figure should be written out in full and should begin with a capital F, also in captions where the whole word is in capital letters (see 12.8–12.11).

14 SPECIES TREATMENT IN TAXONOMIC PAPERS

14.1 The procedure to be followed is illustrated in the example (17.2), which should be referred to, because not all steps are described in full detail.

14.2 The correct name (bold, not italicized) is to be followed by its author citation (italicized) and the full literature reference, with the name of the publication written out in full (not italicized).

14.3 Thereafter all literature references, including those of the synonyms, should only reflect author, page and year of publication, e.g. C.E.Hubb. in Kew Bulletin 15: 307 (1960); Boris et al.: 14 (1966); Boris: 89 (1967); Sims: t. 38 (1977); Sims: 67 (1980).

14.4 The description and the discussion should consist of paragraphs commencing, where possible, with italicized leader words such as *flowering time*, *etymology*, *diagnostic characters*, *distribution and habitat*, with a colon following the leader word and the first word of the sentence beginning with a lower case letter.

14.5 When more than one species of a given genus is dealt with in a paper, the correct name of each species should be prefixed by a sequential number followed by a full stop. Intraspecific taxa are marked with small letters, e.g. 1b., 12c., etc.

14.6 Names of authors are written as in 13.6, irrespective of whether the person in question is cited as the author of a plant name or of a publication.

14.7 The word ‘figure’ is written as ‘fig.’, and ‘t.’ is used for both ‘plate’ and ‘tablet’ (but see 12.9 for normal text).

14.8 Literature references providing good illustrations of the species in question may be cited in a paragraph commencing with the word Illustrations followed by a colon. This paragraph is given after the last paragraph of the synonymy, see 17.2.

14.9 When new combinations are made, the full literature reference must be given for the basionym, e.g.:

Antimima saturata (L.Bolus) H.E.K. Hartmann, comb. nov.

Ruschia saturata L.Bolus in Notes on Mesembrianthemum and allied genera, part 2: 122 (1929). *Mesembryanthemum atrocinctum* N.E.Br.: 32 (1930). Type: *Pillans BOL18952* (BOL, holo.–photo!).

14.10 Treatment of subspecies. Example:

37. **Acacia robusta** Burch., Travels in the interior of southern Africa: 442 (1824); Harv.: 281 (1862); Oliv.: 349 (1871) pro parte excl. specim. *Wehwitsch*; Palmer & Pitman: 807 (1973). Type: Cape Province, Kuruman Dist. Takoon [Litakun], *Burchell* 2265 (K, holo.!).

[The species description encompassing the subspecific characteristics and notes on distribution should follow here.]

Two subspecies are distinguished:

Leaf rachis glabrous or almost so; pods straight or slightly curved 37a. subsp. **robusta**
Leaf rachis sparsely to densely pubescent; pods usually ± falcate 37b. subsp. *clavigera*

37a. subsp. **robusta**.

Brenan in Flora zambesiaca 3,1: 103 (1970); Ross: 37 (1971).

A. robusta Burch.: 442 (1824). [this is the basionym]

[The diagnostic description of the subspecies or reference to above key and notes on distribution should follow here.]

37b. subsp. **clavigera** (E.Mey.) Brenan in Flora zambesiaca 3,1: 104 (1970); Ross: 193 (1973). Type: Natal, near Port Natal [Durban], *Drège s.n.* (K, iso.!, P, fragm.!).

A. clavigera E.Mey., Commentariorum 1: 168 (1836); Benth.: 510 (1875); Brenan: 365 (1958).

[The diagnostic description of the subspecies or reference to above key and notes on distribution should follow here.]

15 CITATION OF SPECIMENS

15.1 Type specimen in synopsis: the following should be given (if available): country (if not in RSA), province, grid reference (at least for new taxa), locality as given by original collector, modern equivalent of collecting locality in square brackets (if relevant, e.g. Port Natal [now Durban]), quarter-degree square, date of collection (optional), collector’s name and collecting number (both italicized).

15.2 The abbreviation s.n. (*sine numero*) is given after the name of a collector who usually assigned numbers to his collections but did not do so in the specimen in question (see 15.11), or the herbarium number can then be cited with no space between the herbarium and its number e.g. *Marloth SAM691* (see 17.2). The herbaria in which the relevant type(s) are housed are indicated by means of the abbreviations given in the latest edition of *Index Herbariorum*.

15.3 The holotype (holo.) and its location are mentioned first, followed by a semicolon, the other herbaria are arranged alphabetically, separated by commas.

15.4 Authors should indicate by means of an exclamation mark (!) which of the types have been personally examined.

15.5 If only a photograph, microfiche or **Aluka image** was seen, write as follows: *Anon.* 422 (X, holo.–BOL, photo!), or *Anon.* 422 (X, holo.–**Aluka image**, website accessed 14-08-2009).

15.6 Lectotypes or neotypes should be chosen for correct names without a holotype. It is not necessary to lectotypify synonyms.

15.7 When a lectotype or a neotype are newly chosen, this should be indicated by using the phrase ‘here designated’ (see 17.2). If reference is made to a previously selected lectotype or neotype, the name of the designating author and the literature reference should be given. In cases where no type was cited, and none has subsequently been nominated, this may be stated as ‘not designated’.

15.8 In brief papers mentioning only a few species and a few cited specimens the specimens should be arranged according to the grid reference system: Provinces/countries (typed in capitals) should be cited in the following order: Namibia, Botswana, Limpopo (previously Northern Transvaal, Northern Province), North-West (pre-

viously northeastern Cape and southwestern Transvaal), Gauteng (previously PWV), Mpumalanga (previously Eastern Transvaal), Free State (previously Orange Free State), Swaziland, KwaZulu-Natal (previously Natal), Lesotho, and Northern Cape, Western Cape and Eastern Cape (Figure 1).

15.9 Grid references should be cited in numerical sequence.

15.10 Locality records for specimens should preferably be given to within a quarter-degree square. Records from the same one-degree square are given in alphabetical order, i.e. (–AC) precedes (–AD), etc. Records from the same quarter-degree square are arranged alphabetically according to the collectors' names; the quarter-degree references must be repeated for each specimen cited.

15.11 The relevant international code of the herbaria in which a collection was seen should be given in brackets after the collection number; the codes are separated by commas. The following example will explain the procedure:

KWAZULU-NATAL.—2731 (Louwsburg): 16 km E of Nongoma, (–DD), 10-10-1960, *Pelser 354* (BM, K, PRE); near Dwaarsrand, *Van der Merwe 4789* (BOL, M). 2829 (Harrismith): near Groothoek, (–AB), *Smith 234*; Koffiefontein, (–AB), *Taylor 720* (PRE); Cathedral Peak Forest Station, (–CC), 8 July 1905, *Marriot s.n.* (KMG); Wilgerfontein, *Roux 426*. Grid ref. unknown: Sterkstroom, *Strydom 12* (NBG).

15.12 For records from outside southern Africa authors should use degree squares without names, e.g.:

KENYA.—0136: Nairobi plains beyond race course, *Napier 485*.

15.13 Monographs and revisions: in the case of all major works of this nature it is assumed that the author has investigated the relevant material in all major herbaria and that he has provided the specimens seen with determinavit labels. It is assumed further that the author has submitted distribution maps for all relevant taxa and that the distribution has been described briefly in words in the text. Under the heading 'Vouchers' no more than five specimens should be cited, indicating merely the collector and the collector's number (both italicized). Specimens are alphabetically arranged according to collector's name. If more than one specimen by the same collector is cited, they are arranged numerically and separated by a comma. **A collector's name and the voucher number(s) is separated from the next collector by a semicolon.** The purpose of the cited specimens is not to indicate distribution but to convey the author's concept of the taxon in question.

15.14 The herbaria in which the specimens are housed are indicated by means of the abbreviation given in the latest edition of *Index Herbariorum*. They are given between brackets, arranged alphabetically and separated by commas behind every specimen as in the following example:

Vouchers: *Arnold 64* (PRE); *Fisher 840* (NH, NU, PRE); *Flanagan 831* (GRA, PRE), *840* (NH, PRE); *Marloth 4926* (PRE, STE); *Schelte 6161, 6163, 6405* (BOL); *Schlechter 4451* (BM, BOL, GRA, K, PRE).

15.15 If long lists of specimens are given, list them together before Acknowledgements under the heading *Specimens examined*. **They are arranged alphabeti-**

cally by the collector's name and then numerically for each taxon. The species is indicated in brackets by the number that was assigned to it in the text and any infraspecific taxa by a small letter; **this number follows the specimen number.** If more than one genus is dealt with in a given article, the first species of the first genus mentioned is indicated as 1.1. This is followed by the international herbarium designation. Note that the name of the collector and the collection number are italicized:

Acoccks 14724 (1.13a) BOL, K, P; *12497* (2.1b) BM, K, PRE. *Archer 1507* (1.4) BM, G.

Barker 9738 (1) NBG; *1916* (2) NBG; *295, 4766, 9478, 9796, 10330* (4) NBG; *1919* (5) BOL, NBG; *1917, 1923, 1935, 2570, 2606, 2646, 3332, 4198, 4858, 10534, 10801* (5) NBG. *Burchell 2847* (2.8c) MB, K. *Burman 2401* (3.3) MO, S. B.L. *Burt 789* (2.6) B, KMG, STE.

Esterhuysen 11497 (1) BOL; *1433* (5) BOL; *71402* (5) NBG.

16 SYNONYMS

16.1 In a monograph or a revision covering all of southern Africa, all synonyms based on types of southern African origin, or used in southern African literature, should be included.

16.2 Illegitimate names are designated by *nom. illeg.* after the reference, followed by non with the author and date, if there is an earlier homonym.

16.3 Nomina nuda (*nom. nud.*) and invalidly published names are excluded unless there is a special reason to cite them, for example if they have been used in prominent publications.

16.4 In normal text, Latin words are italicized, but in the synopsis of a species Latin words such as *nom. nud.*, *et al.* are not italicized (see 13.5, 17.2).

16.5 Synonyms should be arranged chronologically into groups of nomenclatural synonyms, i.e. synonyms based on the same type, and the groups should be arranged chronologically by basionyms, except for the basionym of the correct name which is dealt with in the paragraph directly after that of the correct name.

16.6 When a generic name is repeated in a given synonymy it should be abbreviated to the initial, except where intervening references to other genera with the same initial could cause confusion (see 13.4).

17 DESCRIPTION AND EXAMPLE OF SPECIES TREATMENT

17.1 Descriptions of all taxa of higher plants should, where possible, follow the sequence: Habit; sexuality; underground parts (if relevant). *Indumentum* (if it can be easily described for the whole plant). *Stems/branches*. *Bark*. *Stipules*. *Leaves*: arrangement, petiole absent/present, pubescence; blade: shape, measurements, apex, base, **texture, colour; margin; midrib: above/below; petiole**. *Inflorescence*: type, shape, measurements, position; bracts/bracteoles, involucre bracts: inner, outer. *Flowers*: shape, measurements, sex, colour. *Receptacle*. *Calyx*. *Corolla*. *Disc*. *Androecium*. *Gynoecium*. *Fruit*. *Seeds* (**apply the same sequence of relevant features as in flowers**). *Flowering time*. *Chromosome number*

(reference). *Conservation status*. Figure number (word written out in full).

17.2 Example (not factual for this species):

1. **Englerophytum magalismontanum** (Sond.) T.D.Penn., *The genera of Sapotaceae*: 252 (1991). Type: Gauteng, Magaliesberg, Zeyher 1849 (S, holo.-BOL, photo!).

Bequaertiodendron magalismontanum (Sond.) Heine & Hemsl.: 307 (1960); Codd: 72 (1964); Elsdon: 75 (1980).

Chrysophyllum magalismontanum Sond.: 721 (1850); Harv.: 812 (1867); Engl.: 434 (1904); Bottmar: 34 (1919). *Zeyherella magalismontana* (Sond.) Aubrév. & Pellegr.: 105 (1958); Justin: 97 (1973).

Chrysophyllum argyrophyllum Hiern: 721 (1850); Engl.: 43 (1904). *Boivinella argyrophylla* (Hiern) Aubrév. & Pellegr.: 37 (1958); Justin et al.: 98 (1973). Types: Angola, Welwitsch 4828 (BM!, lecto., here designated; PRE!); Angola, Welwitsch s.n. (BM!).

Chrysophyllum wilmsii Engl.: 4, t. 16 (1904); Masonet: 77 (1923); Woodson: 244 (1937). *Boivinella wilmsii* (Engl.) Aubrév. & Pellegr.: 39 (1958); Justin: 99 (1973). Type: without locality and collector [B, holo.f.; K!, P!, lecto., designated by Aubrév. & Pellegr.: 38 (1958), PRE!, Sl, W!, Z!].

Bequaertiodendron fruticosa De Wild.: 37 (1923), non Bonpl.: 590 (1823); D.Bakker: 167 (1929); H.Fr.: 302 (1938); Davy: 640 (1954); Breitenbach: 117 (1959); Clausen: 720 (1968); Palmer: 34 (1969). Type: Mpumalanga, Tzaneen Dist., Granville in Herb. Pillans K48625 (K, holo.); G!, P!, PRE!, Sl—Aluka image, website accessed 14-08-2009).

B. fragrans auct. non Oldemann: Glover: 149, t. 19 (1915); Henkel: 226 (1934); Stapleton: 6 (1954).

Illustrations: Harv.: 812 (1867); Henkel: t. 84 (1934?); Codd: 73 (1964); Palmer: 35 (1969).

Woody perennial; main branches up to 0.4 m long, erect or decumbent, grey woolly-felted, leafy. **Bark** smoothish, pale, beige-brown, flaking; lenticellate, splitting longitudinally. **Stipules** paired, spines up to 50 × 45 × ± 2 mm, unmistakably large and flattened, roughly triangular in outline, the flared basiscopic lobe margins folded over in larger stipules, spines held at ± 90° to stem. **Stem** erect, simple or 1- or 2-branched, either from base or from upper stem nodes. **Leaves** linear to oblanceolate, 3–10(–23) × 1.0–1.5(–4.0) mm, obtuse, base broad, half-clasping. **Heads/Inflorescence** heterogamous, campanulate, 7–8 × 5 mm, solitary, sessile at tip of axillary shoots; involucre bracts in 5 or 6 series, inner exceeding flowers, tips subopaque, white, very acute. **Receptacle** nearly smooth. **Flowers** ± 23–30, 7–11 male, 16–21 bisexual, yellow, tipped pink. **Stamens** unilateral and declinate; filaments 7–9 mm long, exerted for 7–8 mm; anthers 3–4 mm long, dull pink. **Ovary** ovoid, ± 3.5 mm long; style dividing near apex of anthers, style branches 3–4 mm long, recurved. **Pappus** bristles very many, equalling corolla, scabridulous. **Capsules/achenes** subglobose, 3-lobed, 6–7 mm long. **Seeds** tetrahedral, colliculate, ± 2 mm long. **Flowering time**: September. **Chromosome number**: 2n = 22. Figure 23B.

17.3 As a rule, shape should be given before measurements.

17.4 In general, if an organ has more than one of the parts being described, use the plural, otherwise use the singular, for example, petals of a flower but blade of a leaf.

17.5 Language must be as concise as possible, using participles instead of verbs.

17.6 Dimension ranges should be cited as in 17.2.

17.7 Care must be exercised in the use of dashes and hyphens. A *hyphen* is a short stroke joining two syllables of a word, e.g. ovate-lanceolate or sea-green, with no space between the letter and the stroke. An *N-dash* (*en*) is a longer stroke commonly used instead of the word 'to' between numerals, '2–5 mm long' (do not use it between words but rather use the word 'to', e.g. 'ovate to lanceolate'; it is produced by typing three hyphens with spaces in between, or in MS Word the code is alt + 0150. An *M-dash* (*em*) is a stroke longer than an N-dash and is used variously, e.g. in front of a subspecific epithet instead of the full species name; it is produced by typing two hyphens with spaces in between, or in MS Word the code is alt + 0151. See also 2.10–2.12.

17.8 The use of '±' is preferred to c. or ca when describing shape, measurements and dimensions (see 13.12).

17.9 The decimal point replaces the comma in all units of measurement, e.g. leaves 1.0–1.5 mm long.

18 NEW TAXA

18.1 The name of a new taxon must be accompanied by at least a Latin diagnosis. Authors should not provide full-length Latin descriptions unless they have the required expertise in Latin at their disposal.

18.2 It is recommended that descriptions of new taxa be accompanied by a good illustration, **preferably a line drawing, or a photograph (second choice)** and a distribution map.

18.3 Example:

109. **Helichrysum jubilatum** Hilliard, sp. nov., *H. alsinoides* DC. affinis, sed foliis ellipticis (nec spatulatis), inflorescentiis compositis a foliis non circumcinctis, floribus femineis numero quasi dimidium hermaphroditorum aequantibus (nec capitulis homogamis vel floribus femineis 1–3 tantum) distinguitur.

Herba annua e basi ramosa; caules erecti vel decumbentes, 100–250 mm longi, tenuiter albo-lanati, remote foliati. *Folia* plerumque 8–30 × 5–15 mm, sub capitulis minora, elliptica vel oblanceolata, obtusa vel acuta, mucronata, basi semi-amplexicauli, utrinque canaliculato-arachnoidea. *Capitula* heterogama, campanulata, 3.5–4.0 × 2.5 mm, pro parte maxima in paniculas cymosas terminales aggregata; capitula subterminalia interdum solitaria vel 2 vel 3 ad apices ramulorum nudorum ad 30 mm longorum. *Bractae involucreales* 5-seriatae, gradatae, exteriores pellucidae, pallide stramineae, dorso lanatae, seriebus duabus interioribus subaequalibus et flores quasi aequantibus, apicibus obtusis opacis niveis vix radiantibus. *Receptaculum* fere laeve. *Flores* ± 35–41. *Achenia* 0.75 mm longa, pilis myxogenis praedita. *Pappi* setae multae, corollam aequantes, apicibus scabridis, basibus non cohaerentibus.

TYPE.—Northern Cape, 2817 (Violsdrif): Richtersveld, (–CC), ± 5 miles E of Lekkersing on road to Stinkfontein, kloof in hill south of road, annual, disc whitish, 7-11-1962, Nordenstam 1823 (S, holo.; E, NH, PRE).

19 NEW PROVINCES OF SOUTH AFRICA (OCT. 1996)

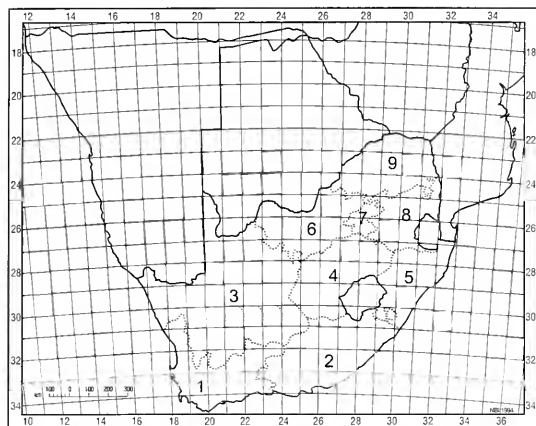


FIGURE 1.—1, Western Cape; 2, Eastern Cape; 3, Northern Cape; 4, Free State (previously Orange Free State); 5, KwaZulu-Natal (previously Natal); 6, North-West (previously northeastern Cape and southwestern Transvaal); 7, Gauteng (previously PWV); 8, Mpumalanga (previously Eastern Transvaal); 9, Limpopo (previously Northern Transvaal, Northern Province).

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Guides to authors of the following publications were made use of in the compilation of the present guide: *Annals of the Missouri Botanic Garden*, *Botanical Journal of the Linnean Society*, *Flora of Australia*, *Smithsonian Contributions to Botany*, *South African Journal of Botany* (including instructions to authors of taxonomic papers), *South African Journal of Science*.

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Manuscripts should be submitted to: The Editor, *Bothalia*, South African National Biodiversity Institute, Private Bag X101, Pretoria 0001.

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24.2 These articles will be considered as a full contribution to the *Flora of southern Africa* and will be listed as published in the 'Plan of Flora of southern Africa', which appears in all issues of the *FSA* series.

25 PLACE NAMES

Ensure that local place names are correct. If in doubt, consult the Internet at

<http://sagns.dac.gov.za/searchplacenameDatabase.asp>

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